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PROCEEDINGS OF THE NPR-A CARIBOU/WATERBIRD IMPACT ANALYSIS WORKSHOP

MAY 11-13, 1982
ANCHORAGE, ALASKA

PRELIMINARY

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CARIBOU: SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

1. The impacts of exploratory activities can be avoided, reduced or mitigated if stipulations appropriate to the season and location are applied. These recommended stipulations are described in the full text.

2. East-west corridors, such as those associated with development in southern or western NPR-A, have great potential for significant adverse impacts on the Western Arctic Herd (WAH) and, to a lesser extent, the Central Arctic Herd (CAH). The risk of significant adverse impacts can be substantially reduced by adopting appropriate corridor design features, requiring convoying or other means of traffic reduction during critial periods and careful regulation of aircraft operations.

3. Areas within the the Western Arctic Herd's central calving area should be withdrawn from the leasing program (Figure 1). Development of oil fields in this area, particularly when considered together with the probable east-west corridor to the Trans Alaska Pipeline System (TAPS) and the possibility of additional fields in southern and eastern NPR-A, represents a level and scope of potential impacts on a migratory caribou population for which there is no historical precedent. Our understanding of caribou biology and that of comparable ungulate species, strongly suggests that the calving and post calving periods are highly sensitive. Oil and gas activities during and immediately after calving are most likely to have sustained demographic consequences. The highly uncertain consequences of oil and gas developments involve a significant risk of disastrous impact on the caribou population.

4. Leasing of areas east, north and south of Teshekpuk Lake should be deferred at least until the end of the proposed five-year leasing program (Figure 1). Prior to any leasing, the Federal government must undertake comprehensive studies of the Teshekpuk Lake Herd (TLH) as a basis for the development of appropriate stipulations and detailed management plans for the area. Deferment of development and production in the Teskekpuk Lake area until after the decline in production from the Kuparuk and Prudhoe Bay fields is strongly recommended.

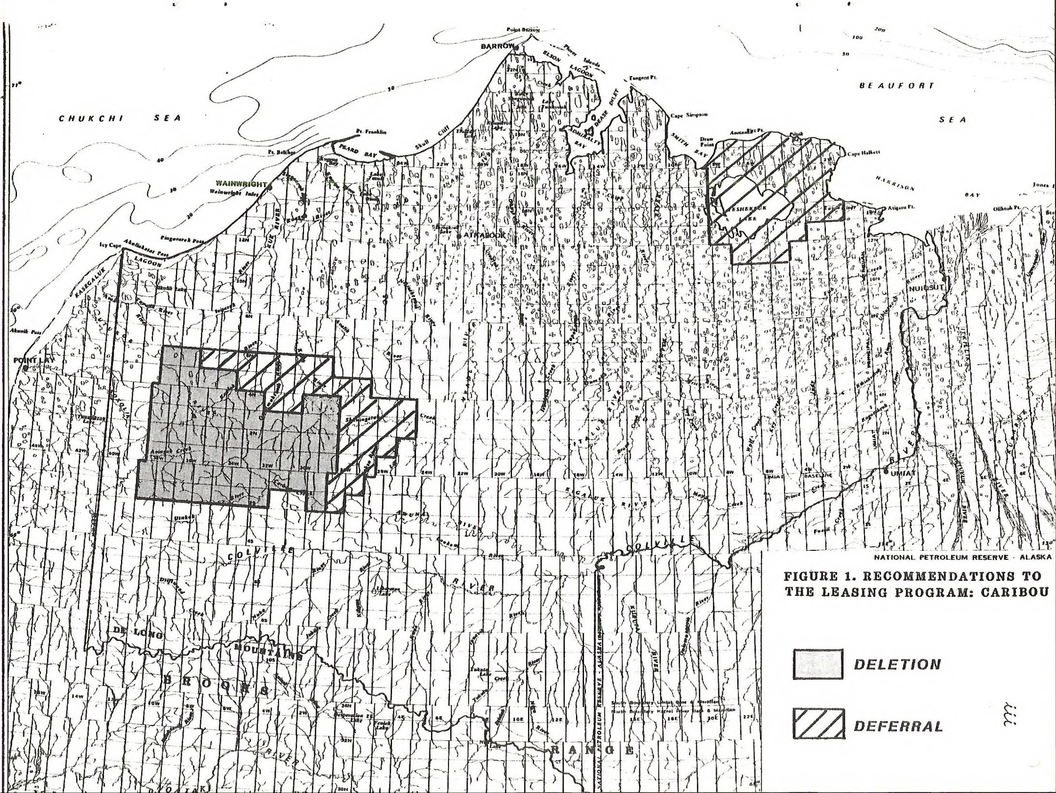


FIGURE 1. RECOMMENDATIONS TO THE LEASING PROGRAM: CARIBOU

WATERBIRDS: SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

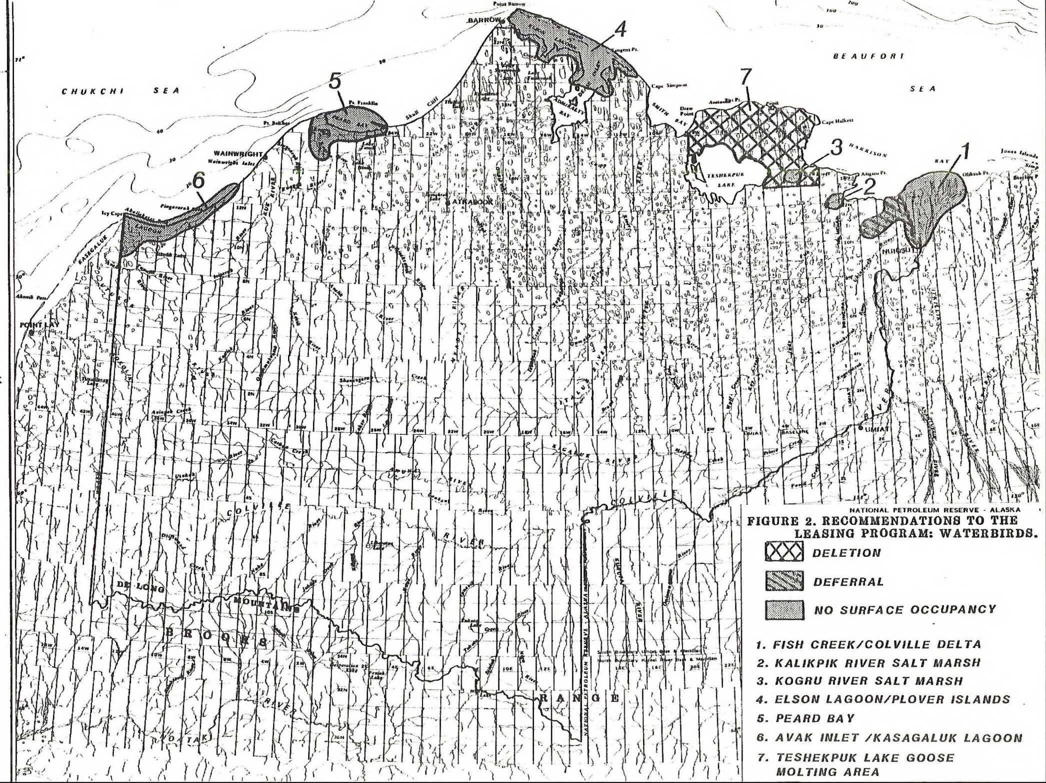
1. Delete the Teshekpuk Lake/Cape Halkett area (Teshekpuk Lake goose molting area) from leasing consideration (see Figure 2).

2. Do not permit any permanent roads to/from Camp Lonely, Cape Halkett or Kogru River DEW Line site.

3. Redesign lease tracts (preferred) or design lease/permitting stipulations to insure no surface occupancy or impacts to the coastal salt marshes, lagoons, barrier islands, or shorelines of: Fish Creek/Colville River Delta; Kalikpik River; Kogru River; Elson Lagoon/Plover Islands; Peard Bay; Avak Inlet /Kasagaluk Lagoon (see Figure 2).

4. Expose the Fish Creek area to leasing last in the 5-year program to allow baseline studies to be completed (see Figure 2).

5. Design and provide for effective enforcement of specific (within 20 miles of the coastline) and general (for all of NPR-A's Coastal Plain) lease/permitting stipulations to protect waterbird habitats and use. These stipulations must be flexible enough to allow additional protections to be placed on any newly identified areas that site-specific studies may indicate are critical to waterbirds.



NATIONAL PETROLEUM RESERVE - ALASKA

FIGURE 2. RECOMMENDATIONS TO THE LEASING PROGRAM: WATERBIRDS.

- ☒ DELETION
- ▨ DEFERRAL
- ▒ NO SURFACE OCCUPANCY

1. FISH CREEK/COLVILLE DELTA
2. KALIKPIK RIVER SALT MARSH
3. KOGRU RIVER SALT MARSH
4. ELSON LAGOON/PLOVER ISLANDS
5. PEARD BAY
6. AVAK INLET /KASAGALUK LAGOON
7. TESHEKPUK LAKE GOOSE MOLTING AREA

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INTRODUCTION

Between February and May of 1982, the Bureau of Land Management (BLM) completed an EIS scoping process for future oil and gas leasing in the National Petroleum Reserve in Alaska (NPR-A) beyond the initial leasing limits provided in P.L. 96-514 (USDI/BLM, 1982 a & b; McVee, 1982). In reviewing the comments received during the scoping process, it became obvious that public and agency concerns regarding NPR-A oil development sharply focused on possible impacts on caribou and waterbirds.

At the end of the scoping process, BLM convened the NPR-A Caribou/Waterbird Impact Analysis Workshop (May 11-13, 1982; at the Holiday Inn, Anchorage, Alaska) to accomplish two purposes:

° To gather state-of-the-art information on the predicted response of caribou and waterbird populations on and adjacent to NPR-A to potential oil and gas development for use in the draft EIS on further leasing; and

° To solicit the individual and collective opinions of the gathered experts on Arctic caribou and waterbirds on the direction the NPR-A oil and gas leasing, exploration and development programs should take.

The selection of scientists for the Workshop was a difficult task considering the number of qualified experts expressing an interest in attending. Final selection of the the panelists was based on:

° A desire to keep the panels small and limited to scientific peers in Arctic biology with no agency or public non-participating observers;

° A desire to sample the scientific community's best professional knowledge and judgement without any industry or agency imposed formal or informal policy or political restrictions;

° The availability of the chosen scientists to participate from May 11-13; and

° BLM funding and travel restrictions.

In the end, the Workshop was composed of the scientists noted in Sections II and III. Mr. James K. Gilliam, BLM/NPR-A Program Staff, served as the Workshop coordinator and as a member of each panel as required.

OBJECTIVES

To accomplish the two purposes described in the Introduction, the attending scientists were briefed on:

° The NPR-A leasing process including the EIS, responsibilities of various agencies, decision points and opportunties for flexibility in required stipulations;

° The actions and hypothetical oil and gas development scenarios to be analyzed; and

° The definitions and terminology to be used so that all Workshop participants would utilize the same terms and frames of reference.

Following this initial briefing, the attending scientists were asked to actively participate in intensive, highly structured separate panel discussions for either caribou or waterbirds with the following specific objectives:

- To describe the predicted impacts on caribou or waterbirds with respect to a provided list of specific actions associated with petroleum exploration, development, production and transportation to markets;
- To assess, based on the action-effect pairs developed in the first objective, the expected specific impacts and relative cumulative impacts on caribou and waterbird resources that could potentially result from various illustrative development scenarios for NPR-A;
- To describe the geographic limits within which these site-specific and cumulative impact assessments may be extrapolated. That is, describe and delimit zones within NPR-A that have comparable environmental sensitivities with respect to caribou or waterbird resources; and
- To describe those effects on caribou or waterbirds resulting from NPR-A oil and gas development that in the best professional judgement of the panelists are "...highly uncertain or involve unique or unknown risks."

METHODS

The Workshop originally intended to utilize a modified Delphi approach combined with peer group interaction to accomplish its purposes and specific objectives. Under this approach, each scientist would have been asked to write out their personal response to various questions posed from the specific objectives. These individual responses would then have been presented to the peer group in typed form for peer interaction. This process would have been repeated many times in an attempt to reach a collective opinion.

However, as soon as the Workshop formed into the two panels, it became evident that the time-consuming modified Delphi approach and the protections it provided to both minority and majority opinions would not be necessary. Panelists were not timid about expressing their professional opinions or challenging another panelist's carefully constructed chain of logic. Therefore, the success of the Workshop depended more upon the abilities of the two panel leaders than upon a particular discussion format. The panel leaders, Dr. Lent and Dr. Truett, decided what was to be discussed, when discussion was to end and how a panel consensus was to be reached on a particular issue or recommendation. The panel leaders also decided when additional hypothetical development assumptions or real world examples were required from the Workshop coordinator.

MODELING HYPOTHETICAL PETROLEUM DEVELOPMENT IN NPR-A

In December 1981, prior to any lease sales on NPR-A, James K. Gilliam and Keith Bennett of the BLM/NPR-A Program Staff began modeling hypothetical petroleum development in NPR-A. The rationale for and the results of this modeling process, with some modification, served as the basis for Shepard, Bennett and Gilliam (1982). However, the models developed for this Workshop and those presented in Shepard et al. (1982) are not identical although they share a common rationale. The models developed specifically for this Workshop were utilized for all biological impact predictions in the draft EIS.

To facilitate panel discussion of the likely level and type of impacts which might result from NPR-A leasing and subsequent development, four combinations of oil fields (or plays) were simulated. This simulation procedure involved the following steps:

- ° Estimating a total discovery and production case (the probable level of economically recoverable hydrocarbons for NPR-A);
- ° Identifying several combinations of fields which would, when taken together, have lifetime production approximating the probable total discovery and production case for NPR-A;
- ° Developing sketches of the physical arrangement of such fields to address the question of how much land would be altered. That is, what is the likely design of an NPR-A oil field and how would such a field affect the land it occupies; and
- ° Describing the activities and facilities that would accompany field development such as roads and pipelines or other structures which influence wildlife behavior or human activity which creates visual disturbances or noise which, in turn, causes stress or avoidance reactions in wildlife.

Further discussion of these simulation procedures is contained in Shepard et al. (1982). Descriptive geographical names were given to each hypothetical field to facilitiate discussion references. The four cases which were utilized for discussion purposes are shown in Figures 3-6. An example which gives the reader an insight into how much land a given complex of fields would occupy or directly affect is provided in Figure 7.

At the start of the Workshop, the panelists were presented with all hypothetical development models and background material needed to drive the Workshop analyses. Although only a few of these documents were actually utilized in the Workshop, a complete listing includes:

- ° Play #1: Liberator to Prince Creek to TAPS with graphics (Figure 3 in this document) and narrative.
- ° Play #2: Chipp/Alaktak to Kogru/Smith to Kuparuk with graphics (Figure 4 in this document) and narrative.
- ° Play #3: Eastern Composite - Utukok/Avingak and Liberator to Prince Creek to TAPS and Chipp/Alaktak to Kogru/Smith to Kuparuk with graphics (Figure 5 in this document) and narrative.
- ° Play #4: Western Composite - Liberator to Utukok/Avingak with Peard Bay/Point Belcher to Cape Thompson/Chariot with graphics (Figure 6 in this document) and narrative.

- List of Actions (Table 3 in this document).
- Idealized NPR-A Development Timeline (Table 1 in this document).
- Possible NPR-A EIS Leasing Strategies (Table 4 in this document).
- NPR-A Exploration: Standard Practices
- Lease/Oil Field Development On-the-Ground Activities.
- Road/Pipeline Construction On-the-Ground Activities.
- Illustrative Development/Workshop Scenarios
- The "Red Tape" Process: Federal Control of NPR-A Oil and Gas Leasing, Exploration and Development.

All of the Workshop modeling and informational documents, pertinent correspondence and the Workshop agenda have been included in a Memorandum to File (Gilliam, 1982) Subject: The NPR-A Caribou/Waterbird Impact Analysis Workshop/Modeling Documents and will not be reproduced in their entirety in this document. However, the following items are reproduced because they are necessary to understand the panel proceedings.

Figures 3-6 representing hypothetical Plays Nos. 1-4 were the mapped models utilized in the Workshop. The rationale and analysis that led to the creation of these hypothetical plays is, as previously mentioned, adequately provided in Shepard et al. (1982) except for two points. Only four plays were designed because of time limitations. All corridors shown on the play maps were provided for illustration purposes only and have no relationship to any type of terrain, engineering or biological feasibility analysis. Corridors were originally plotted on USGS 1:250000 maps. For the most part, these corridors follow the numerous tractor or winter "trails" shown on these USGS maps. These trails are actually scars left on the tundra surface from the passage of vehicles in the early days of NPR-A exploration beginning in the 1940's. The trails represent only a convenient routing for an illustrative corridor and not a required or optimal routing.

Table 1, the idealized development timeline, assumes all exploration results are positive and was developed with the assistance of the Alaska offices of the U.S. Geological Survey and Mineral Management Service. Table 2 summarizes the assumed timelines of the four hypothetical cases or plays. Detailed narratives of each play's exploration, development and production assumptions were presented at the Workshop but are not necessary to understand the proceedings. Table 3 is a partial list of actions occuring during oil and gas exploration and development and represents a summary of more detailed narratives supplied to the Workshop. Table 3 was utilized in the action-effect exercises within each panel. Table 4 was presented to the panelists as a method of standardizing their recommendations to the EIS process and the leasing/permitting programs. It represents a draft of the leasing strategies developed for analysis in the EIS.

FIGURE 3

PLAY NO. 1

LIBERATOR TO PRINCE CREEK TO TAPS

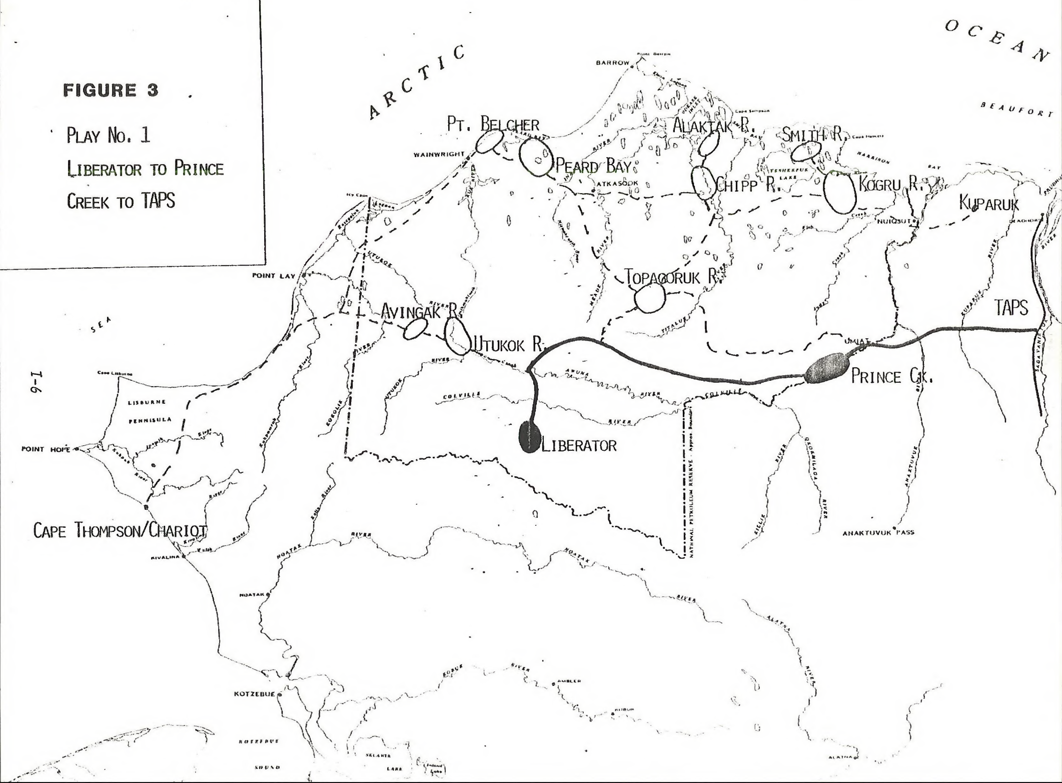

FIGURE 4

PLAY NO. 2

CHIPP/ALAKTAK TO

KOGRU/SMITH TO KUPARUK

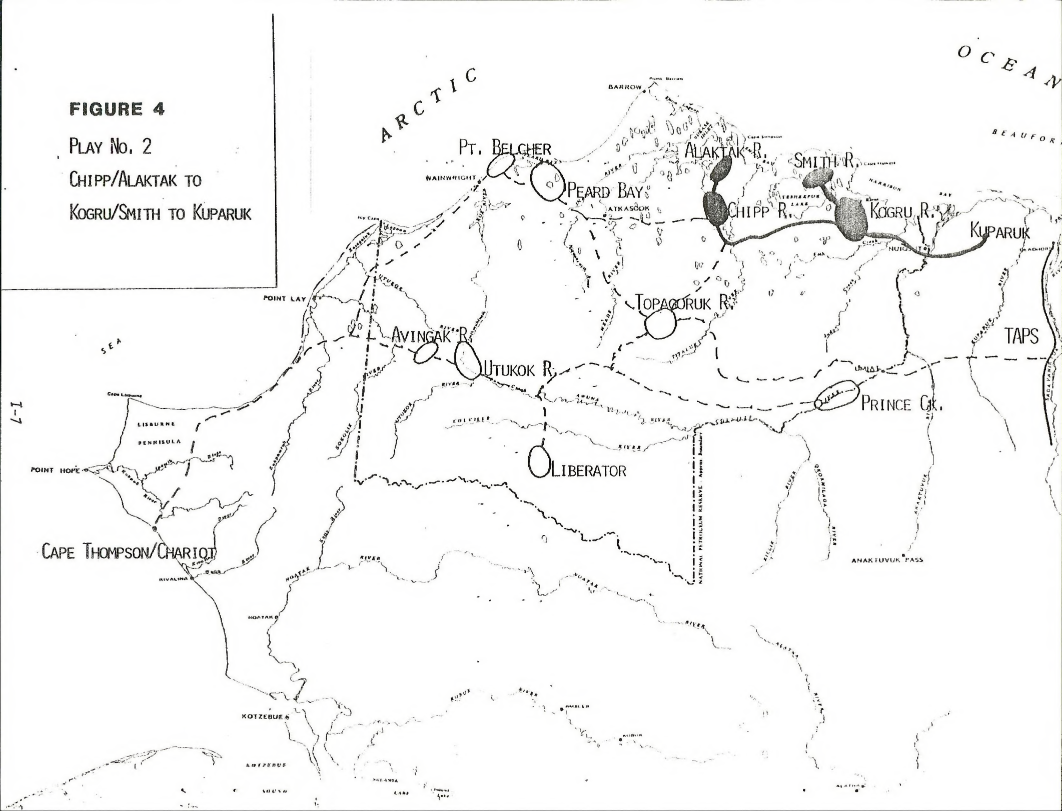

FIGURE 5

PLAY NO. 3
UTUKOK/AVINGAK TO LIBERATOR TO PRINCE CREEK TO TAPS AND CHIPP/ALAKTAK TO KOGRU/SMITH TO KUPARUK

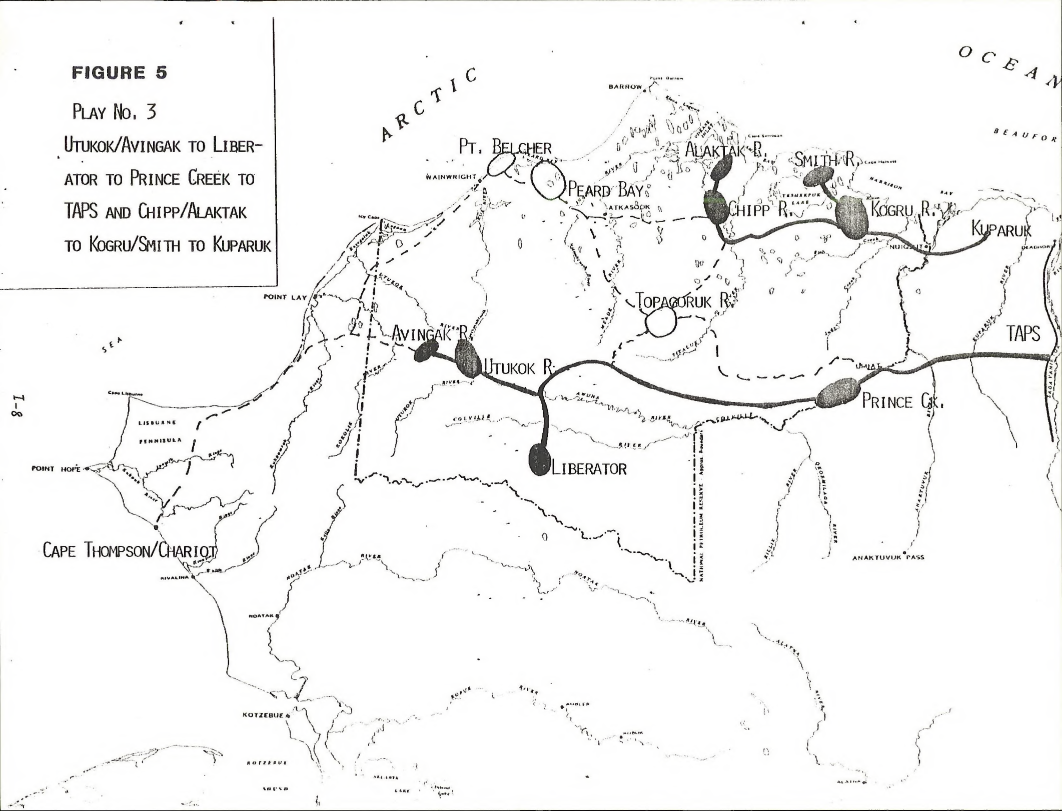

FIGURE 6

PLAY NO. 4

LIBERATOR TO UTUKOK/AVINGAK WITH PEARD BAY/PT. BELCHER TO CAPE THOMPSON/CHARIOT

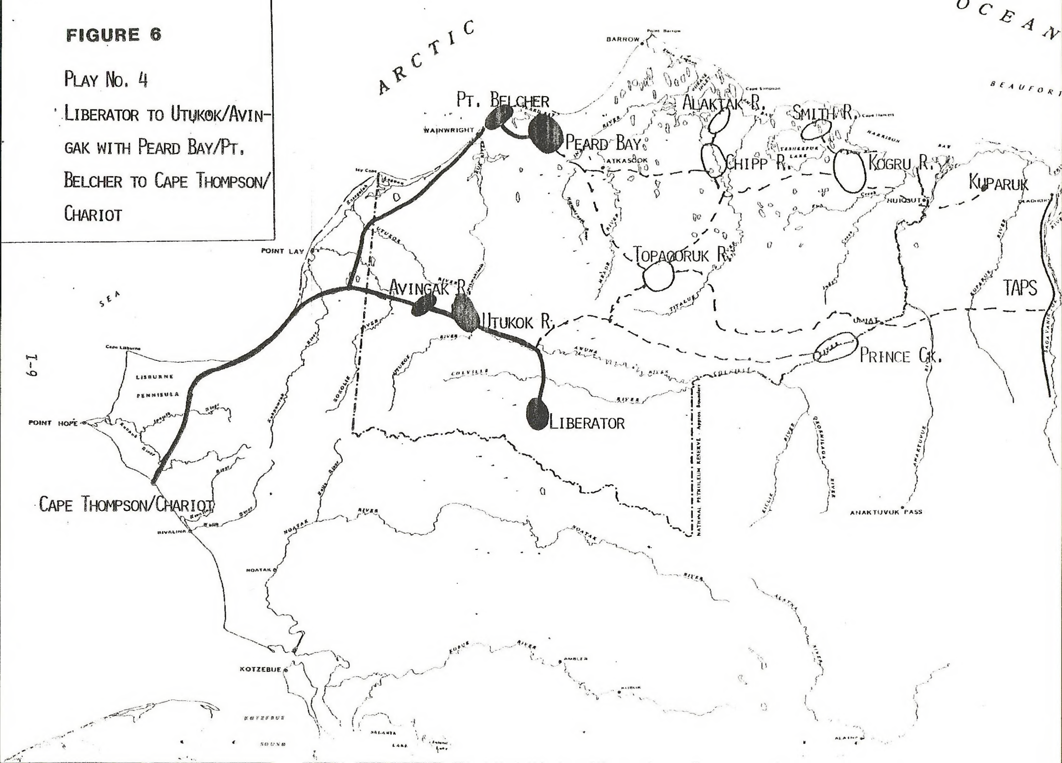

FIGURE 7. TYPICAL FIELD CHARACTERISTICS FOR NPR-A HYPOTHETICAL DEVELOPMENTS

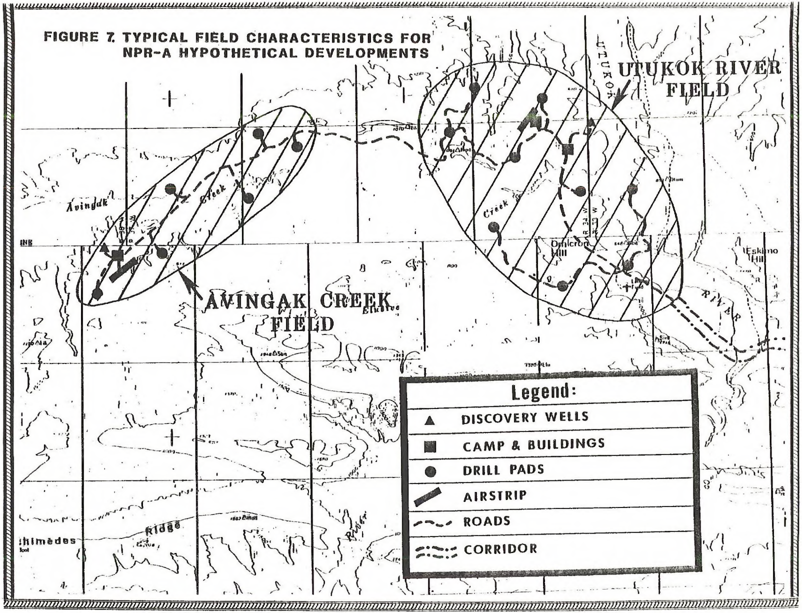

TABLE 1. SUMMARY OF DEVELOPMENT TIMELINES FOR THE TEN NPR-A HYPOTHETICAL FIELDS.

FIELD NAMES	LEASED	EXPLORATION BEGINS	DEVELOPMENT BEGINS	PRODUCTION BEGINS
LIBERATOR	1982	1983	1989	1997
PRINCE CREEK	1983	1984	1989	1996
CHIPP RIVER	1983	1984	1991	1997
ALAKTAK RIVER	1983	1990	1995	1998
KOGRU RIVER	1987	1990	1995	2002
SMITH RIVER	1987	1994	2000	2002
UTUKOK RIVER	1988	1989	1996	2001
AVINGAK CREEK	1988	1996	2001	2003
PEARD BAY	1987	1988	1995	2002
PT. BELCHER	1987	1988	1998	2002

TABLE 2. IDEALIZED NPR-A DEVELOPMENT TIMELINE (Leases from 1982 Sales)

ACTIVITY	RESPONSIBILITY	TIMELINE
1982 Summer geophysical, engineering and/or environmental survey(s)	* Applicant under BLM ** lead permit	6/82-9/82
1982-83 Winter geophysical survey	" "	11/82-3/83
1983 Summer exploration surveys	" "	6/83-9/83
1983-84 Winter geophysical survey	" "	11/83-3/84
1983-84 Winter TEST well #1: (All wells) Construct pad, ice airstrip, water source. Spud well and TEST formation.	Applicant under MMS lead permit	11/83-3/84
1984 Summer Cleanup: Test well #1:	" "	6/84-9/84
1984 Summer exploration surveys	Applicant under BLM lead permit	6/84-9/84
1984-85 Winter geophysical survey	" "	11/84-3/85
1984-85 Winter TEST well #2: Spud well and PROVE formation	Applicant under MMS lead permit	11/84-1/85
1984-85 Winter Test well #3: Spud well to DELINEATE formation	" "	1/85-3/85
1984-85 Winter Test well #4: Spud well to DELINEATE formation	" "	1/85-3/85
1985 Summer Cleanup: Test wells #2,3,&4	" "	6/85-9/85
Prepare Plan of Operations for field development for submittal to MMS	Applicant under MMS guidelines	3/85-7/86
Prepare ROW application for road/pipeline for submittal to BLM, State and Borough	Road/Pipeline Operator(s) under agency guidelines	3/85-7/86
Prepare NEPA document: Field Development	MMS	7/86-10/87
Prepare NEPA document: ROW	BLM, State, Borough	7/86-10/87
Begin Field Development	Applicant under MMS lead permit	11/87-
Begin Road Construction	Operator under Federal, State and Borough permits	11/87-
Begin Pipeline Construction	" "	11/88-
PRODUCTION COMMENCES		DECEMBER 1991

* APPLICANT= LESSEE OR THEIR AGENT ** LEAD PERMIT = AGENCY WITH PRIMARY ENVIRONMENTAL PROTECTION RESPONSIBILITY

TABLE 3. LIST OF ACTIONS.

Seismic/Winter

- Cat Trains (Men, Vehicles, Green/Brown Trails)
- Primitive Ice Airstrips
- Seismic Explosions
  - Above/Belowground
  - Debris/Surface Damage
- Aircraft Operation
  - Fixed Wing/Twin Otter, Herc
  - Helicopter/survey and seismic
- Vibersies Technique/nonexplosive
- Water Source/Waste Disposal

Seismic/Summer

- Aircraft Operation
  - Fixed Wing/float or wheeled
  - Helicopter/continious operation along one seismic line or wide ranging survey and resupply
- Seismic Explosions
  - Above/Belowground
  - Debris/Surface Damage
- Camps/field and base
- Water Source/Waste Disposal
- Human Presence and Recreation

Exploration Well/Winter Only

- Initial Cat Train Access
- Ice Airstrip and Traffic
- Ice Roads (Surface Damage?)
- Thin Pad Design
- Water Source/Waste Disposal
- Sand/Gravel Borrow Areas
- Drilling Activities
- Summer Rehabilitation

Exploration Well/All-Season

- Initial Cat Train Access
- Ice Airstrip/Ice Roads
- Thick Pad Design
- Permanent Airstrip and Camp Roads
- Off-Road Traffic/hovercraft, rolligon
- Air Traffic/fixed wing and helicopter
- Gravel/Sand Source
- Rehabilitation
- Drilling Operations
- Water Source/Waste Disposal
- Human Presence and Recreation

Oil Field Development

- Permanent Camp
- Human Presence and Recreation
- Construction of All-Season Pads
- Drilling Operation
- Permanent Airport and Traffic
- Scheduled Airline Service
- Some Facilities Not Lessee Owned
- Road Network, Traffic and Repair
- Sand/Gravel Source
- Water Source/Waste Disposal
- Rehabilitation/interim and upon abandonment

Haul Road Construction and Operation

- Survey (field camps, aircraft operations)
- Temporary Construction Camps
- Human Presence and Recreation
- Traffic On/Off Road
- Bridges
- Gravel/Sand Sources
- Aircraft Operation/fixed wing and helicopter
- Use of Explosives
- Road Watering/Oiling/Grading for dust control
- Water Source/Waste Disposal
- Public Access

Pipelines

- Survey
- Pump Station Construction and use with airstrips
- River Crossings
- Construction and Use of Acess Trails
- Winter and Summer Construction Activities
- Ditching/Stringing/Lowering/Raising/Backfilling/
- Inspection Surveys
- Testing
- Leaks

Cape Thompson Terminal

- Construction
- Operation
- Additional Impacts from Use as Mineral Ore Loading Point

Sealift Points on NPR-A

- Construction
- Operation
- Airstrip
- Road to Field
- Causeways

TABLE 4. Possible NPR-A EIS Leasing Strategies

I. No Special Requirements - Ordinary protection of resource values as generally required by BLM.

II. Selective Deletions - Under this alternative certain lakes, portions of the wild and scenic study rivers, and some coastal features (capes and bays) and river deltas could be deleted from leasing.

III. No Surface Occupancy Leasing - Under this alternative any lands in the study area could be leased but operations could not take place on any sensitive area.

IV. Phased Leasing - Under this alternative critical habitats would be identified and leasing would be phased so that not all of the critical habitat would experience simultaneous operations. An example would be leasing only 20 percent of class five wetlands at any given time and requiring that initial leases be relinquished or allowed to expire before additional class five wetland leasing can take place.

V. Design Solution Leasing - Under this alternative all lands could be offered for leasing, but the oil and gas operations which take place in a sensitive environment would have to be specially designed or managed to:

   A. reduce the number of personnel (who must be) in the sensitive environment by substituting capital goods, such as pipeline leak detecting systems, for labor; and,

   B. reduce the frequency of human activity within or above the sensitive environment by, for example, using inventory control models to assure that a facility will not have to receive supply flights during critical lifecycle periods of key species.

VI. Seasonal Restriction Leasing - Under this alternative all lands could be offered for leasing but during certain critical periods of each year all oil and gas related operations would cease. An example is the field shut-in option which Conoco has so successfully employed in the Aransas National Wildlife Refuge, critical to Whooping Cranes.

VII. Deferred Leasing - The State of Alaska is on record that simultaneous impacts on the calving grounds of the Western Arctic Herd, the Porcupine Herd and the Central Arctic Herd be precluded by not leasing more than one calving ground at any given time. Under this alternative the Utukok calving grounds of the Western Arctic Herd would be deferred to avoid simultaneous impacts on caribou.

VIII. Special Management - Inventory and assessment work done for the oil and gas leasing decision may indicate that critical resource values might best be protected either as Wild and Scenic Rivers or some other restrictive classification (such as a Birds of Prey Natural Area or Area of Critical Concern). This is not properly an oil and gas leasing alternative. It is included to shed light on conclusions which may come after the EIS.

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CARIBOU DISCUSSION PANEL (CDP)

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FINDINGS OF THE CARIBOU DISCUSSION PANEL (CDP)

The panel agreed on three identifiable "populations at risk" that could potentially be impacted by petroleum leasing and development on the National Petroleum Reserve in Alaska (NPR-A). Based on the panel's present understanding, these following three caribou "herds" should be treated as separate but interrelated entities for impact assessment and management purposes: the Western Arctic Herd (WAH), the Central Arctic Herd (CAH) and the Teshekpuk Lake Herd (TLH).

The panel was unable to estimate or predict impacts of various plays or scenarios in terms of demographic changes, such as percent decline of a herd. However, the panel was able to describe levels of exposure to potentially impacting actions and structures and, using this information coupled with a general understanding of the periods of sensitivity to such actions, was able to make some broad conclusions about relative risks of impacts.

ASSESSMENT OF EXPLORATORY PHASE IMPACTS

Seismic and exploratory actions were usually treated generically rather than as part of a specific play. Winter seismic operations on NPR-A were considered to have had no significant impacts on caribou to date. It was predicted that exploration would be unlikely to have significant impacts in the future, assuming comparable levels of activities and adequately enforced stipulations.

The panel considered the following winter exploration stipulations regarding caribou as minimum requirements:

1. All activities must cease by mid-May;
2. Standard stipulations prohibiting aircraft harrassment must be effective;
3. Hunting prohibitions must be adequately enforced; and
4. Adequate clean-up must be accomplished.

The Teshekpuk Lake area is clearly the area of greatest concern with regard to potential impacts of winter seismic operations. The 4,000-5,000 animals of the Teshekpuk Lake Herd (TLH) depend on this area year-round. Therefore, within the TLH's range, greatest attention must focus on restricting the overall level of permissible activities and assuring strict adherence to stipulations.

Summer seismic (geophysical) operations were considered to be acceptable, as described under present BLM guidelines, with the following provisions:

1. No operations are to be allowed from mid-May to June 20;
2. Surveillance must be effectively established to assure strict adherence to aerial harassment stipulations, especially in the vicinity of post-calving aggregations;
3. Hunting by personnel in geophysical crews must be prohibited; and

4. Adequate clean-up must be accomplished during and after all operations.

Winter exploratory drilling operations were deemed to have little or no significant impact if undertaken with the same stipulations and regulations as described for winter seismic operations. Deep exploratory wells requiring reoccupancy of a site for drilling in a second winter for completion were considered preferable to all-season operations. This was considered the only acceptable procedure for calving areas and immediately adjacent sites. Such operations should be designed so that summer custodial and maintenance activity is minimized. All operations on or near calving areas should be designed so that no maintenance or support aircraft operations are required between mid-May and June 20. Surface occupancy should be kept to an absolute minimum.

ASSESSMENT OF HYPOTHETICAL PLAYS

Following a general consideration of exploratory activities, the panel shifted its attention to specific hypothetical "plays" or scenarios for production and transport of oil from NPR-A.

Play No. One: Liberator to Prince Creek to TAPS (Figure 3)

This Play or scenario was used as a starting point because some of the tracts involved were already leased or were likely to be leased prior to the start of the five-year leasing program under consideration. The hypothetical Liberator Field is a possible starting point for NPR-A development regardless of the outcome of subsequent leasing decisions.

The following analysis responds only to the general scenario, primarily the size and placement of fields and corridors. It does not consider any specifics regarding timing of events or actions because this level of detail is beyond the "state-of-the-art" for impact prediction given the relative uncertainty surrounding size and location of any field actually discovered.

In this scenario, the habitats included in two hypothetical fields, Liberator and Prince Creek, were identified as habitats receiving primarily short-term caribou use during periods of rapid seasonal movements. Some longer-term winter use by small numbers of caribou might be involved at Prince Creek Field but the direct loss of habitat due to displacement or decreased use of the fields themselves was considered insignificant. Conceptually, the oil fields could be considered as segments or extensions of the corridors and as significant focal points for human activities.

The probability that the Liberator Field corridor would be a potential barrier to caribou movements is greatest during the pre-calving movement. Large numbers of WAH caribou typically move toward the calving grounds after coming through Anaktuvuk Pass, Killik Pass, and Etivluk Pass. It is highly likely that up to 50,000 caribou would encounter the corridor in early May. There is a 90 percent probability that 20 percent or more of the entire WAH population, including 50 percent or more of the adult females, would encounter the corridor at this time in a given year.

Given the enforcement of general stipulations and design criteria for corridors that effectively regulate corridor use during the pre-calving period, it was concluded the corridor would have only a minor behavioral influence on pre-calving animals, perhaps equivalent overall to a one-day delay or minor deflection in reaching optimal calving locations.

The nearer the encounter occurred to the peak of the calving period (that is, the later in May the encounter occurred), the more likely pregnant cows were to act in a highly sensitized fashion, as if they were cows with calves.

If the field and northward directed arm of the corridor were shifted to the west, some caribou would encounter the corridor at the height of the calving season. If it were further east, it would be encountered earlier in the pre-calving period. If Liberator Field were located further south towards the Brooks Range, even more cows would contact it and its corridor.

A less likely event, but one thought to be of potentially greater impact, is a major post-calving migration encounter with this corridor. Normally, the post-calving aggregations pass to the south of the Liberator Field location in Play No. One. There is a ten percent chance that 50 percent to 75 percent of the Western Arctic Herd would encounter the field/pipeline corridor complex within a month after the peak of calving. There is a 90 percent probability that ten percent or more of the WAH would do so. This ten percent consists of peripheral groups that move parallel to the main aggregation or split off from it in late June or early July. The probability of such a major event would increase substantially if the Liberator Field were located a few miles further south.

After the post-calving aggregations pass to the south of the Liberator Field, there is a northward summer movement in which large groups (one to several thousand), comprising roughly 50 percent of the population, would be expected to encounter the long east-west segment of the corridor. Portions of these large groups would normally spend part of the summer drifting around in the zone occupied by the corridor. Most of the 50 percent or so of the herd that moved north in summer would come back through the corridor/field area in autumn, heading south into the mountains. Animals that summered west of the corridor might be included in some years or the major southward movement could occur to the west of the Liberator Field but all caribou moving through Anaktuvuk Pass in the fall would have to cross or avoid the corridor.

Given the elements of this play, it is possible that a single caribou cow would have to encounter and cross or avoid this major east-west corridor four times in order to complete its annual cycle. On three of these occasions, it would be accompanied by a calf varying in age between two weeks and four months. Of all encounters, those associated with post-calving are viewed as most likely to have significant adverse impacts. The rationale for this conclusion is presented below.

The portion of the corridor extending east of Prince Creek Field and connecting to the Trans Alaska Pipeline System (TAPS) would be encountered by Central Arctic Herd caribou moving to and from winter ranges. Up to 50 percent of this herd could encounter this extension of the main TAPS corridor twice a year.

Various mitigation measures were recommended to minimize barrier effects. These are not mutually exclusive and combinations of all or most measures will be needed to effectively minimize impacts. These restrictions or conditions include:

1. If the topography and permafrost regime will allow pipeline burial in certain areas, particularly where these areas coincide with traditional caribou routes, the pipeline should be buried;

2. The panel proposed that convoying or other traffic control measures on any haulroad be an essential condition for leasing and development. Convoying measures could be effective for dealing with infrequent, large-scale encounters such as during pre-calving and post-calving. Industry should be notified that some type of traffic control system will be required between TAPS and any NPR-A fields during the May 15 to July 15 period;

3. Spacing between pipeline and haulroad may be important. Increasing the separation of the pipeline and haulroad may provide two separate sets of potentially less disturbing stimuli rather than a combined single stimulus. Separating the road and pipeline may significantly reduce the barrier effect. This is a working hypothesis which is being experimentally tested (Curatolo, in prep.); and

4. A haulroad serving two major oil fields that are both in development or production phases will have much more traffic than one serving a single field. While recognizing that the options available to the government may be relatively limited in this regard, the panel nevertheless recommended consideration of phasing leasing and development. This topic was also considered in Play No. Three.

Play No. Three: Utukok/Avingak to Leberator to Prince Creek to TAPS and Chipp/Alaktak to Kogru/Smith to Kuparuk

This scenario involves development of paired oil fields in the Utukok River area serving as an extension of the Liberator Field development described in the previous play. Generally all impacts described previously would occur, plus any additional impacts associated with these fields and the westward corridor extension. This scenario has an east-west corridor dividing NPR-A, as well as the range of the Western Arctic Herd, into two portions.

The hypothetical Utukok-Avingak Fields would occupy a significant portion of the known calving grounds of the Western Arctic Herd. Roughly 150 square miles of the 1,100 square mile core calving area would be subject to development that would at least partially displace some caribou that normally use it. The concern for development in the specific locations in this play is accentuated because these fields lie in the very core of the calving area used for many years by the majority of calving cows.

In this play, there is a probability greater than 90 percent that most adult cows in the WAH population would be in or encounter the fields at least once immediately before, during or after calving. Based on experience elsewhere, it can be predicted that some cows will enter the fields and carry out or attempt to carry out normal maternal behavior while others will avoid the fields. Overall, the effect will alter the movements and distribution of cows and associated caribou over the calving grounds. Displaced animals will be mixed with those who have distributed themselves normally in other parts of the calving area.

Interpretation of such events is complicated by the fact there is no general agreement as to the biological significance of year-to-year variations in distribution over the calving area. On the one hand, it has been agreed that differences in environmental variables, such as snow cover (Lent, 1965 and 1980) and forage quality (Kuropat and Bryant, 1980) are obvious and, therefore, it must be assumed that caribou respond adaptively, even if not perfectly. Some panelists argued that while there must be clear advantages in selection of the general area, much of the observed movement and milling about of groups within the area may be largely due to chance and random events. Animals are often seen to move through seemingly favorable locations to seemingly less favorable ones. The latter viewpoint tends to place more emphasis on the occupation of a general area which, over the long-term, will provide the optimal calving environment.

In terms of effects on individuals, a cow entering and persisting in using calving habitat within a field would:

1. Still be able to locate optimum forage, unless she was prevented from leaving the field at the optimal time after calving;

2. Be subject to levels of disturbance above normal "background" levels;

3. Spend less than a "typical" proportion of time feeding;

4. Find localized movements restricted and time consuming;

5. Be subject to traffic and other accidental forms of mortality at above-normal levels;

6. Be more likely to abandon or be separated from her neonate calf than normal; and

7. Be subject to somewhat less-than-normal chances for predation-related mortality.

Those cows that were displaced or deflected by a field and moved to other areas to calve would:

1. Be placed in a less-than-optimum calving environment; and

2. Share this environment at a higher-than-normal density.

In any case, there was agreement that an oversimplified picture of events at and around calving time was prevalent. That is, the picture of a cow arriving, picking a birth location and, then, within a couple of days after parturition, moving off the calving area is too simple. In fact, groups do mill about the calving area, some mixed with pregnant and post-partum cows, especially as post-calving aggregations form. Thus, an individual female before and after parturition might have two or three encounters with the fields and adjoining corridors before entering the true post-calving aggregations and movements. These encounters could involve thousands of cows with calves under one week old, an age when their capability to negotiate barriers, relocate their mothers and recognize potentially dangerous objects or situations is still extremely limited.

In recent years, large fractions (up to 40 percent) of the Western Arctic Herd have wintered on the Coastal Plain portion of NPR-A. These animals apparently begin calving in the northern portion of the calving area south of Point Lay. Thus, there is a distinct possibility that the fields and corridor could cause a split within the present WAH with coastal wintering cows staying north and east, and the southern wintering ones staying south and east of the corridor. The long-term consequences of such an event are highly unpredictable, but the movements and integrity of the herd could be altered.

The panel agreed that the calving period was the time in the annual cycle when habituation by cows to disturbing stimuli was least likely to occur. This conclusion was reached both from direct observations and from a theoretical basis. Increased sensitivity and reduced likelihood of habituation applies equally to the disturbances associated with air traffic to and from any calving area developments. The summer shut-down stipulations considered essential for acceptable exploratory activities in and around the calving area would presumably not be feasible stipulations for a development phase.

Play No. Three with a field or fields in the Utukok River drainage connected via a corridor to TAPS, would represent a "worst case" scenario for caribou. The north-south corridor from the Liberator Field into the Utukok Uplands is the most significant part of this overall worst-case situation.

In Play No. Three, a cow could encounter various developed areas and potential barriers seven or eight times in a year, given any sort of development along the approximate pattern and scale of this scenario. The majority of these encounters would be during the calving, post-calving and summer periods considered most sensitive for reasons discussed later.

The panel firmly concluded that the only way to prevent the potentially highly adverse impacts on caribou in the calving area, as well as an overall pattern of development which would provide an array and scale of impacts unprecedented in northern development, is to withdraw specific areas from leasing (see Figure 1).

In recent years, probably in conjunction with the coastal wintering tendency, there has been some shift toward use of a more northerly and easterly calving area. Therefore, it is recommended that leasing of certain tracts adjoining those above be deferred until long-term trends become more obvious or shifts in use return to normal (see Figure 1).

For the Western Arctic Herd, limited developments in the Coastal Plain of NPR-A as in Play No. Three would have relatively little impact. Displacement would probably not involve more than about 5,000 or so wintering caribou in a typical year. Somewhat fewer caribou would normally drift into the area in summer. There is no evidence that winter range here is limited and should not present a problem even if access was significantly reduced. There are, however, specific design stipulations that should be required where corridors cross winter ranges. These relate specifically to reducing barrier effects caused by drifting snow in conjunction with the man-made features. These stipulations may include:

1. Increased elevation of a pipeline so that the greater clearance will provide for unimpeded surface snow movement to eliminate drifts in most years.

2. Greater spacing of pipeline laterally from the roadbed to decrease the possibility of drifting;

3. Short burial sections; and

4. Use of ramps and knowledgeable design to take advantage of topographic features which may enhance winter crossing success.

Hypothetical fields at Kogru River and Smith River in Play No. Three were placed entirely within the range of the Teshekpuk Lake Herd (TLH). The identity and behavior of this herd has only been revealed within the past five or six years as a result of field work undertaken both in response to the decline of the Western Arctic Herd and as part of the general NPR-A studies (P. Reynolds, USF&WS, unpubl. report).

The general picture available at present is that 4,000 to 5,000 caribou of the TLH are remaining relatively distinct from the Western Arctic Herd and performing short seasonal movements that maintain them year-round in an area around Teshekpuk Lake and extending southward into the northern foothills. Thus, the range of this group seems to be even more confined than that of the comparable Central Arctic Herd.

During four of the past five years, a field in the vicinity of the Smith River location, shown in Play No. Three, would have been in the core calving area for this small TLH. The area east of Teshekpuk Lake, where the Kogru Field is located, is ordinarily peripheral calving area. Should these or comparable developments occur, as much as 20 percent of the calving area of the Teshekpuk Lake Herd would be impacted. This compares with about five percent of the calving area of the Central Arctic Herd that is presently occupied by existing Prudhoe Bay and Kuparuk oil field developments. As with the Central Arctic Herd, little is known about the history and trends in the TLH. There are indications that a group of caribou with comparable movement patterns was present in the same area 40 to 50 years ago. Post-calving routes and early summering areas for the TLH are not yet clearly definable, partly because of lack of study and partly because of the "compressed" nature of this herd's range and apparent overlap of use zones. Cows with calves have been observed later in summer on the same areas used for calving. Some post-calving groups would certainly pass through both fields. Fall movements apparently take some or most of the herd south of the Chipp River-Kogru corridor in Play No. Three, at least for part of the winter. Other caribou are observed wintering north of Teshekpuk Lake and to the immediate south and southwest, but apparently few winter to the east. Some of these wintering caribou may be associated with the Western Arctic Herd.

Because of the relative sedentary, "resident" nature of the Teshekpuk Lake Herd, certain types of stipulations or mitigation measures, such as convoying of road traffic and rerouting of aircraft flights for critical periods, would not be as practical or effective as with the Western Arctic Herd.

Other implications of this lack of separation of seasonal TLH ranges are not as clear. The overlap of seasonal ranges seems to be even greater than with the Central Arctic Herd. This could mean that habituation would be more likely or it could lead to more drastic impacts because of simultaneous effects at more than one point in their annual cycle.

It is assumed that these resident Arctic coastal caribou depend upon an extremely small "window" of time in which they are in positive energy balance, perhaps even shorter than in the Prudhoe Bay area (White et al. 1975) and, therefore, are especially sensitive to any disruption of their delicately balanced energy status. The validity of this assumption can be questioned, however, because to date, relatively good calf production and survival has been reported.

The topographic environment of the Teshekpuk Lake Herd is such that special attention would be required for siting of any structures with the potential for producing disturbance or barrier effects. Kogru Field, for example, could occupy the entire area between Teshekpuk Lake and the coast. Because the movements of this herd center around the lake, there is an unusual potential for disruption of movement patterns.

The Teshekpuk Lake Herd, provides an opportunity to obtain baseline information prior to leasing, which was not done at Prudhoe Bay. The desirability for this is explained later.

There are definite environmental advantages to deferring leasing and development in the Teshekpuk Lake area as long as possible (Figure 2). These include:

1. Preventing the continuous development of the coastal strip from Prudhoe Bay to Teshekpuk Lake. Free access to at least a portion of this insect relief habitat and summer use zone should be maintained. Deferment until after the peak of Kuparuk-Prudhoe Bay development would aid this goal.

2. Similarly, deferment until after peak development at Kuparuk and Prudhoe Bay will help stabilize rate of traffic and level of disturbance of a NPR-A/Kuparuk corridor and aid the Central Arctic Herd as well.

3. Realistic possibilities may exist for leasing at the periphery of the TLH range with "no-surface-occupancy" stipulations. However, at the present time there is insufficient information from which to design such a leasing program.

Play No. Four: Liberator to Utukok/Avingak with Peard Bay/Pt. Belcher to Cape Thompson/Chariot

Play No. Four contains the same Play No. Three fields developed in the calving grounds that were determined to involve extremely high risk of unacceptable environmental impacts. The potential problems associated with development in the calving areas are not changed in this scenario.

A hypothetical corridor from Avingak Field to Cape Thompson would in some years (perhaps less than one out of two) be encountered by early post-calving aggregations that could total 75 percent of the total Western Arctic Herd.

A few thousand (perhaps 10,000 typically) caribou would also have to cross the corridor or stay near the corridor in order to use normal summer range west of the Point Belcher to Cape Thompson hypothetical corridor routing. This coastal zone contains important insect relief habitat.

Similarly, in winter a few thousand caribou are often found on range along and to the west of the corridor. The same hills and bluffs that provide insect relief are often relatively snow-free in winter. Major fall migrations, observed to involve up to 90,000 caribou in the past, would occasionally follow a route roughly parallel with the Point Belcher to Cape Thompson corridor.

The impacts on the caribou population resulting from corridor effects in this play are relatively minor compared to the field impacts. However, the western corridor may influence herd behavior so as to decrease availability for subsistence use in villages such as Point Hope, Wainwright and Kivalina.

THE SENSITIVITY OF CARIBOU DURING THE CALVING/POST-CALVING PERIOD

There was general agreement throughout the workshop discussions that caribou are most sensitive to disturbance during the calving, post-calving and summer periods. This is essentially the position reached by Jakimchuk (1980) in an exhaustive review of the subject.

It has been emphasized that Rangifer populations depend upon a narrow window of time in which individuals are in a positive energy balance and are able to achieve body growth. This may be as short as a few weeks. Thus any stress, disturbance, or reduced availability of optimum forage at this time may have particularly severe consequences (Reimers, 1972; White et al. 1975; White and Trudell, 1980; Klein, 1980).

The summer growth rate of young calves is especially critical because calf weight in fall is the most important determinant of probability of suvival as well as for the age a female will enter puberty (Ponamarev, 1938; Preobrazhenskii, 1961). This sensitivity of juvenile mortality rates and late juvenile fecundity to inadequate nutrition and similar habitat deficiencies is widespread among ungulates (Caughley, 1976) but is especially pronounced and significant in Rangifer because of the short growth period and because adult fecundity is relatively fixed. Adult females are rarely barren but do not produce more than one offspring even under optimum conditions. Therefore, juvenile survival and their recruitment to the population is one of the most significant variables in Rangifer population dynamics (Doerr, 1980). Furthermore, young, primiparous mothers are most susceptible to abandoning their offspring due to disturbances or poor conditions (Ponamarev, 1938).

Insect harassment and infestation have also been implicated as factors contributing to mortality, especially in juveniles (Helle, 1980). The excellent condition of reindeer in relatively insect free areas such as Svalbard has been noted by several authors (Reimers 1977 and 1980; Klein, 1958). Predation of young calves in summer can be significant and is apparently highly variable (Doerr 1980; Bergerud, 1980; Miller and Broughton, 1970).

RECOMMENDATIONS FOR FUTURE STUDIES AND RESEARCH

Deferment of leasing of sensitive caribou habitats would gain time to learn from on-going studies and management situations elsewhere. The panel anticipates that in 10 to 15 years, we will have achieved:

1. Better understanding of calf survival rates as they relate to environmental variables, including variables associated with calving grounds;

2. Better understanding of the long-term potential for abandonment of calving grounds (such as Milne Point near Prudhoe Bay) and the demographic consequences of such abandonment or displacement;

3. An improved understanding of the relative impacts of and responses of caribou to different pipeline-road construction modes;

4. Better understanding of insect-related responses and their biological significance, but perhaps not sufficient to predict all cases;

5. Better assessment of energy costs of disturbance and movement in various terrains at various seasons;

6. Better understanding of herd identities and interchanges in northern Alaska;

7. Improved understanding of the process and dynamics of habituation due to successive observations over long-term periods with known individuals.

8. Greater management experience from major development projects affecting reindeer/caribou which are underway in Newfoundland, Labrador, Norway and USSR (Taimyr); and

9. Better information on predation and other mortality rates on calving grounds and summer range.

Specific studies should be undertaken prior to leasing in the Teshekpuk Lake Herd's range so that a detailed description of movements, habitat use and related behavior, including some estimates of the range of annual variation, is available as "baseline" information prior to development. At the same time, studies should be continued to further elucidate the identity and interrelationships of this small resident herd with the larger Western Arctic Herd. Some studies have been initiated while the WAH was at a low point and should be continued as the population increases. The Federal government should take a responsibility for such needed studies prior to leasing. After leasing, it is appropriate for industry to contribute to their continuation.

The panel took the opportunity to discuss long-term research needs which are not presently being funded or for which current support is inadequate. There is a need for both government and industry to support comprehensive studies of basic caribou biology rather than narrow, short-term field studies focused only on specific development proposals or projects. The following major research topics would yield, in the long-term, a better capability to predict and mitigate impacts:

1. Calving ground characteristics: Why is there annual variation in distribution? What is the adaptive significance?

2. Biting and parasitic insect life histories; species differences, ecological and annual variations as related to caribou responses.

3. Energetics and physiology of caribou responses and reactions to biting and parasitic insects.

4. Differential condition and mortality rates between tundra-wintering and taiga-(tundra-forest ecotone) wintering segments of populations. Are they real? If so, why?

5. Energetics of migration and consequences of altered migration routes or delayed migration.

6. Carrying capacity concepts as they apply to migratory caribou. What are the demographic effects of loss/reduction of various types of habitat? Comparison of limiting factors among various herds.

7. Dynamics of summer foraging in relation to plant phenology, changing forage quality, nutrition, etc.

8. Understanding of herd (population) identities. Degree of interchanges, factors influencing, dynamics of shifting ranges and use patterns.

OTHER RECOMMENDATIONS

Two other recommendations arose in the course of the panel's discussion:

1. "Information to Lessee" (ITL) should include specific language "up front" about "freedom of passage" design features and stipulations. This is particularly important for those tracts and areas where special mitigation recommendations have been made. The ITL for Sale 822 focuses entirely on the use of instrumental leak detection systems to reduce human activity along a pipeline. This seemed to the panel to be putting undue emphasis on a very minor part of the overall human disturbance equation. The costs may not warrant the benefits or could be spent more effectively on other caribou impact mitigation measures.

2. There was general agreement that the best hope for protection of the environment and renewable resource values of the Arctic Slope was for government to require comprehensive planning and carefully phased development over the entire Arctic portion of the state. The present piecemeal approach to development on NPR-A, Outer Continental Shelf, State lands, Native lands, and, possibly, the Arctic National Wildlife Refuge, is not desirable for sound management of caribou or other renewable resources.

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SECTION III: PROCEEDINGS OF THE WATERBIRD DISCUSSION PANEL

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INTRODUCTION

The objectives/purposes of the Waterbird Discussion Panel (WDP) within the NPR-A Caribou/Waterbird Impact Analysis Workshop (Workshop) were (1) to determine which of the many waterbird species present on NPR-A, are sensitive to petroleum related exploration and development activities; (2) to discuss the likely response of these sensitive species' populations to these activities; and (3) to recommend leasing and/or permitting strategies which would minimize or eliminate the impacts of these activities. Dr. Joe C. Truett, LGL Ecological Research Associates, served as the panel leader and is to be commended for his ability to direct a group of strongly opinionated biologists in soliciting the ideas and rationales presented in this discussion.

PROCEDURES

The panel did not follow the pre-workshop plan of exhaustive consideration of each potential play/scenario. With few exceptions, all participants were familiar enough with the types of oil and gas exploration and development activities that could lead to waterbird disturbance; therefore, use of the play/scenarios was largely restricted to illustrating particular points of discussion.

Chronologically, the panel considered the following topics:

May 11th

* Areas of NPR-A with intensive use by waterbirds or especially sensitive concentrations (Areas of Special Concern)
* The importance of the NPR-A coastal "Zone" to waterbirds

May 12th

* Recommendations for the BLM/MMS NPR-A regulatory program
* Activities that disturb waterbird use of NPR-A habitats
* Suggested mitigation options at the leasing and permitting stages
* Brief exercise with Plays Nos. Two and Four
* Area specific recommendations for the NPR-A leasing/permitting program

May 13th

* Specific literature references to support panel conclusions
* Sensitivities of shorebirds
* Sensitivities of waterfowl
* Selection of sites for NPR-A seaports

- * Magnitude of expected impacts from oil field development activities in the Teshekpuk Lake goose molting area
- * Research recommendations

RESULTS

This section combines the results of the three days' dialogue into broader topics. No attempt was made to follow the chronology of the panel's formal topical disussion.

I. What are the NPR-A Waterbirds and What are Their Sensitivities?

The panel did not utilize any NPR-A checklist to select species or groups for discussion. Selection of waterbirds for discussion was based on the expertise of the participants. Some waterbirds were discussed on an individual species basis and some species were considered only as a part of a larger group all of which were expected to exhibit somewhat similar responses to development. Failure to mention a particular species of waterbird by name in the panel's discussions does not imply it is unimportant; it simply means that with limited time, the panel considered as many species or groups of species as possible while consolidating some species for general consideration.

Waterbird discussions within the panel were not limited to NPR-A species. Because of the possibility of a road and pipeline from NPR-A to the Lisburne Peninsula or across the Colville River Delta, other species, such as seabird cliff-nesting colonial species that appear rarely on NPR-A, were also discussed.

The following paragraphs summarize the panel discussions of the sensitivities of each species or group considered:

A. Geese (Black Brant, White-fronted Goose and Canada Goose)

Molting: Impacts may be both direct and indirect from petroleum development or related activities. In July, geese on NPR-A concentrate in large flocks to molt in discrete areas. They concentrate on Coastal Plain lakes that have low-relief lake shorelines dominated by sedges and grasses. The condition of the geese (amount of fat reserve) is the lowest in their annual cycle at this time and feeding occupies up to 60 percent of their time. Disturbance during this period by aircraft, ground vehicles or human presence may reduce the time available for feeding, thereby reducing fat accumulation important for a successful fall migration (Simpson, Hogan and Derksen, in prep.). Disturbances may also increase vulnerability of these flightless geese to predation by flushing birds from protective cover. It must be emphasized that these geese are totally flightless and very disturbance sensitive during molt and must travel overland or swim to move away from harrassment.

Low level overflights by aircraft elicit short term but intense escape behaviors from these molting geese that could result in reduced survival. Vehicular traffic on a permanent road through molting areas may be continuous and therefore more disturbing than low level aircraft overflights as it may lead to displacement from favored habits. It is not known whether molting geese would become habituated to these disturbances.

These predictions of responses to disturbance are based on personal observations of investigators in the goose molting area to the north and east of Teshekpuk Lake (see Figure 2). This area's physical characteristics and intense use by molting geese make it unique on the Alaskan Arctic Slope. The panel felt that development in this area, regardless of the type (permanent roads from Camp Lonely at Pitt Point or from Arctic Slope Regional Corporation lands at Cape Halkett; or even an oil field development capable of complete shut down and evacuation during July) would be unacceptable when weighed against the almost certain displacement of molting geese.

Developments in molting areas may increase the chance of exposure of molting birds to chronic leakage or spillage of toxic materials. Direct and indirect mortality of molting birds from such a spill may be appreciable because they could not fly away from the danger zone.

Geese are very traditional in use of molting sites. These traditional molting sites are usually remote from nesting areas and human disturbance. The Teshekpuk Lake goose molting area attracts geese from many locations outside NPR-A. The Teshekpuk Lake area is used by black brant from Wrangell Island (off the coast of Siberia), MacKenzie and Andersen River Deltas and Banks Island in Canada, western Alaska and the Alaskan Arctic Slope. It was estimated by the panel that 20 percent to of the world's black brant population are present in this area during July.

Two studies have evaluated lake geomorphology and vegetation characteristics of the Teshekpuk Lake/Cape Halkett area in an attempt to understand the factors that attract molting geese to this area. Habitat that appears similar to the Teshekpuk Lake goose molting area is present south of Barrow but is not used by molting geese. Therefore, it is surmised that a unique combination of factors, including subtle differences in physical characteristics, plant community quality, the abundance of drained lake complexes and remoteness of the area may be responsible for the concentration of molting geese. (Derksen et al., 1979 and 1982)

Nesting and Brood Rearing: Geese usually nest in appropriate habitats within NPR-A from early June to mid-July with brood rearing continuing until mid-August. Black brant are the only true colony nesters of the three species. The largest known colony of nesting brant (over 100 pairs) on the Alaskan Coastal Plain is located on a large lake south of Camp Lonely. Other brant nesting colonies are located in the vicinity of the western end of Teshekpuk Lake (about 50 pairs) and in the Colville River Delta (about 300 pairs). Scattered nesting occurs across the Coastal Plain within 40 km of the coast and a small nesting colony may be present in the Fish Creek area (see Figure 2). The colony nesting behavior of brant increases their population's vulnerability to land-based disturbance, especially human foot traffic, which may drive the adults off the nest and expose the eggs or young to chilling and predation by foxes, jaegers or gulls.

With the exception of some pairs of Canada geese that nest along bluffs of the Colville River, there are only rare records of Canada geese nesting within NPR-A. Canada geese with broods have been observed in the Fish Creek area; however, this may represent a dispersal of Canada geese from nest sites in the Colville River Delta to the east of NPR-A.

White-fronted goose nesting is well dispersed throughout suitable Coastal Plain habitats of NPR-A. Population levels of this species would probably not be significantly affected from scattered developments on NPR-A because of the dispersed nature of their nesting. The Colville River Delta, however, has exceptionally high nest densities for the Arctic Coastal Plain.

Staging for Migration: Post-molt concentrations of staging Canada geese occur in the coastal fringe between Cape Halkett and Smith Bay with smaller concentrations in the salt marshes and lagoons from Barrow to the Colville River Delta. Canada geese leave NPR-A to the east, traveling through interior Alaska, British Columbia and southeastern Alaska to wintering areas in Washington and Oregon (King and Hodges, 1979).

In contrast, white-fronts do not congregate in large staging concentrations, but instead follow a narrow eastward migration route along the Arctic coast then south through Canada in the central flyway to wintering areas on the Texas gulf coast.

Black brant stage for migration in two key areas of the Reserve, the coastal marshes of the Cape Halkett Peninsula (now partly owned by the Arctic Slope Regional Corporation) and at Kasegaluk Lagoon in northwestern NPR-A where they gather on their fall migration down Alaska's west coast. Coastal salt marshes along the entire Beaufort and Chukchi sea coasts are utilized during fall migration.

Goose populations that use the marine and coastal estuarine systems are extremely vulnerable to oil spills or other disturbances during the staging period. The consequences of being driven from the traditional staging grounds by disturbance are unknown. The capability of other areas to support mass concentrations of staging birds is also unknown because the dependence of geese on these traditional habitats has not been measured.

Notes: All species of geese may be especially vulnerable to collision with powerlines, towers, and guy wires within the Arctic Coastal Plain. These structures are especially lethal to flying geese during the frequent periods of coastal fog.

B. Ducks

General: Greatest duck use of NPR-A seems keyed to macroinvertebrate abundance, which is usually associated with emergent plants. Various duck species use different wetland types with a diversity of macroinvertebrates and vegetative cover types. Modifications to the ecological balance of aquatic systems on NPR-A may work to the advantage of one species of macroinvertebrate and as a consequence, to that of some duck species that depend on them but to the disadvantage of other macroinvertebrates and their consumers.

Pintails and other Dabbling Ducks: Given the probable levels of NPR-A developments presented in the Workshop, and the site-specific mitigation requirements to be applied to any NPR-A activity, the panel did not feel that the NPR-A populations of pintail or other dabbling ducks would be in jeopardy. However, the importance of NPR-A habitats to pintails and other dabblers is sufficient to warrant concern only if NPR-A development is more extensive than as presented in this Workshop or similar new developments occur elsewhere on the Arctic

Coastal Plain. In addition, the Coastal Plain of NPR-A acts as a significant reserve summer habitat for North American dabbling ducks occasionally displaced by drought in more southerly breeding areas (Derksen and Eldridge, 1980).

Oldsquaws: Oldsquaws are the most widely distributed and abundant breeding ducks on Alaska's Arctic Slope. Beginning in July, males concentrate in coastal lagoons for molting and staging. Females and their young move to the lagoons in August and September. During this open water period (mid-July to mid-August), most oldsquaw use is confined to a small portion of NPR-A's coastal lagoons and nearby inland areas. NPR-A populations of oldsquaw would be highly vulnerable to oil spills in lagoon systems (King and Sanger, 1979). It is important to note that a significant proportion of the entire Beaufort Sea oldsquaw population may use NPR-A lagoon systems during the course of a summer, thus exposing even greater numbers of birds to coastal disturbances (Johnson, S.R. Unpublished report to OCSEAP. Bird Species Accounts). However, the low breeding densities exhibited by oldsquaws should preclude any major impacts from other than coastal development or activities.

King Eider: Ledyard Bay (Nearshore waters between Cape Lisburne and Point Lay to the West of NPR-A) appears to be part of a major migration area corridor and molting area for king eiders. As many as 50,000 king eiders have been calculated to move along the coast per day for 2 to 3 weeks in late June and early July (Springer et al., 1982). Much of the king eider migration in the Chukchi Sea is within a few miles of the coast. The Beaufort Sea coast from Tangent Point Barrow is also an important migratory corridor for king eiders as shown by observations from Copper Island and , more importantly, the "duck camp" at the western end of Elson Lagoon (G.J. Divoky, pers. comm., 1982). The leasing/permitting programs should emphasize protection of both the Chukchi and Beaufort Seas coastal lagoons and salt marshes that are of vital importance to this species.

Common Eiders: Most common eiders nest on barrier islands. Common eiders nest later than most other waterfowl (late June). The barrier islands should be protected from disturbance, particularly as a result of low-flying aircraft and human activities, from late June through July. Low-flying aircraft may frighten adults off of nests, especially during the early part of the nesting cycle, exposing eggs to predation by gulls that nest nearby (Schamel, 1978). Driftwood and other debris on the barrier islands provide nesting sites and should not be removed.

C. Whistling Swans

Nesting and Brood Rearing: The Fish Creek/Colville Delta areas (see Figure 2) have the highest swan nesting densities on or adjacent to NPR-A. Swans are very vulnerable to aircraft and ground disturbance during nesting, brood rearing and fledging.

Molting: Little information is available on the precise location of swan molting sites in NPR-A. About 35 swans have been observed during molt in the Meade River Delta and flocks have been seen west of Teshekpuk Lake. However, regular use of this site is not well documented. Swan tenacity to traditional molting sites is also unknown. Swans appear to use a variety of wetland types but prefer large *Arctophila fulva* wetlands that provide food during the summer.

Staging for Migration: The river delta systems of the Arctic Slope, especially those of the Colville, Sagavanirktok and Kuparuk Rivers, appear to be major staging areas in September. The Colville River Delta is known to host about 200 post-breeding birds prior to their migration.

Population Status: King (1970) estimated that a total of 800 swans may use the Alaskan North Slope. The panel felt this estimate was conservative and suggested that at least 800 swans may occur on NPR-A alone.

Notes: Whistling swans, like geese, may also be especially vulnerable to collision with power lines, towers, and guy wires, especially those erected along the coastline.

D. Shorebirds

General: Shorebirds may be relatively tolerant to all but the concentrated presence and actions of men and machines. However, they are sensitive to changes in their habitats such as alterations in natural drainage, water quality, increased dust levels, vegetation structure changes, and oil or fuel spills. Subtle effects such as increased predation by Arctic foxes as a result of human activities may also be important (Norton, Ailes and Curatolo, 1975, Hanson and Eberhardt, 1979).

Shorebirds do not seem to be limited by nesting habitat although food availability in the nesting areas on the Arctic Slope may be limited (Holmes, 1966 and 1970). It is not known, however, if their feeding habitats on the salt marshes and barrier islands of the coastline are critical to their survival during migration and staging (Connors, Myers and Pitelka, 1979).

Phalaropes (Northern and Red): The vulnerability of phalaropes to petroleum development activities is similar to that of oldsquaws in that they utilize the NPR-A lagoon systems for migratory staging from mid-July to early September. Their greatest vulnerability would be to oil or fuel spills on the lagoon shorelines. The majority of the young-of-the-year Arctic Slope phalaropes use the Beaufort and Chukchi Sea lagoons during the open water period each summer and move from one lagoon to another along the coast (Doug Schamel and Diane Tracy, In Prep., University of Alaska; Johnson, S.R. 1981).

Calidrid Sandpipers and Plovers (Western, Semipalmated, Pectoral, Baird's and Buff-breasted Sandpipers; American Golden and Black-bellied Plovers; and Dunlin): Large populations of these birds (mainly post-fledging young) utilize the NPR-A littoral zone and salt marshes during the course of the summer (post-nesting and during migration). These birds, as a group, are primarily vulnerable to impacts from oil spills in the littoral fringe. It is uncertain how oiling or destruction of coastal fringe habitat, especially salt marshes, would affect sandpiper and plover population levels. Unlike geese, these shorebirds are carnivorous; therefore, effects on food chains, predominantly terrestrial and aquatic invertebrates, would in turn effect them.

E. Gulls and Terns

Ross' Gull: This species is of greatest concern in the third and fourth week of September when 50 - 75 percent of the world's population of 4,000 birds are present in nearshore marine waters from Wainwright to the central Plover

Islands (see Figure 2). Oil spills in this area, especially during the time of concentration, could be devastating to this species because of their feeding habits. These birds apparently are attracted to this area to feed on concentrations of Euphausiid shrimps in the Chukchi and Beaufort Sea waters.

Glaucous Gull: According to the panel, almost all possible impacts on or concerning glaucous gulls can be prevented if they are not attracted to developments. Reducing the amount of garbage available to these gulls is usually considered in the facility design phase but difficult to control in the operations phase because of worker handouts and the usual accumulation of garbage. The results of attracting large numbers of gulls can be serious for other bird species: avian disease and parasite transmission and increased predation by the attracted gulls on other local birds, their eggs and young are but two considerations. Therefore, provisions for reducing garbage availability to gulls must be carefully analyzed in any site-specific impact analysis.

Arctic Terns: Large numbers of terns concentrate in marine waters in the vicinities of Peard Bay, Kasegaluk Lagoon and Elson Lagoon from late July to early September and utilize the lagoons, salt marshes and barrier islands. Arctic terns migrate southward in fall along the Chukchi Sea coast (Lehnhausen and Quinlan, 1981). Although terns are tolerant of most human disturbances, their feeding behavior may make them susceptible to oil sheens on the surface of coastal waters .

F. Other Waterbirds

Murres: Common and thick-billed murres do not nest on NPR-A but were considered by the panel because of the scenario to utilize a new seaport on the Lisburne Peninsula for transport of oil to market. The murre colonies at Capes Lisburne, Lewis and Thompson to the west of NPR-A support 400,000 to 600,000 murres which represents about half of the total Chukchi Sea population. Murres are vulnerable to aircraft disturbance at their colonies (including loss of eggs and chicks as a result of flushing large numbers of incubating and brooding birds off narrow nest ledges) and to oil or fuel spills in Ledyard Bay or in the Chukchi or Bering Sea feeding areas. As with geese and swans, murres may also be susceptable to collisions with coastal radio towers, guy wires or transmission lines.

Kittiwakes: Concerns with regard to the black-legged kittiwakes are similar to those of murres in their expected response to most disturbances. However, aircraft disturbance at the colonies does not appear to pose as great a problem. Kittwakes utilize the nearshore waters along Ledyard Bay for feeding and large numbers of them congregate to rest, bathe and collect nesting material at several specific locations including the mouth of Thetis Creek and the Pitmegea River.

It appears that before any detailed impact analysis on a site-specific basis for a pipeline leaving NPR-A to the west could be done, the nearshore use of Ledyard Bay must be mapped for kittiwake use and intensive use sites along the coastline be given special protections from disturbance or alteration.

Black Guillemots: About 12-15 percent (150-200) black guillemots of the Alaskan population occupy Cape Lisburne and vicinity. About 160 breeding pairs and 700 non-breeding individuals inhabit Cooper Island, a barrier island in Elson Lagoon. The feeding behavior of guillemots makes them susceptible to oil or fuel spills at sea and in Ledyard Bay. Guillemots at Cape Lisburne appear to be sensitive to disturbance at their nest sites but those using Cooper Island appear to be more tolerant to some forms of human disturbance (Divoky, 1979) suggesting habituation may occur. The guillemot population on Cooper Island is vulnerable to mammalian predators if such predators could gain access via a causeway. Removal of surface debris which provides nesting cover is also a major concern. Providing artificial nesting sites on Cooper Island has proven to be a successful means for establishing or increasing nesting colonies (Divoky, 1979).

II. NPR-A Areas of Special Concern with Respect to Waterbirds

The following narrative is a combination of all three days of panel discussions. Figure 2, depicts all areas on NPR-A as they were tentatively defined by the panel. These areas were identified on the basis of: (1) known areas of concentration of waterbirds; (2) areas that have received at least cursory investigation; and (3) areas known to be critical to waterbirds such as the Teshekpuk Lake goose molting area. Other areas, such as Smith Bay and Dease Inlet were recommended for further study and possible addition to this list.

A. Fish Creek/Colville River Delta

Although the Colville River Delta is not legally a part of NPR-A (it is a mixture of State, Native Corporation and private ownership), the panel considered it as a continuous habitat with the Fish Creek area. The following is a synopsis of waterbird use:

* Black brant - nesting colonies (300 pairs) and feeding in salt marshes during staging.

* White-fronted geese - highest nest densities on Alaska Arctic Slope; brood-rearing; and staging on lakes and salt marshes.

* Canada geese - some reports of breeding, brood-rearing and staging.

* Whistling swan - highest nesting concentrations on the Arctic Slope; brood-rearing and staging.

* Loons (especially yellow-billed) - nesting.

* Shorebirds (semipalmated sandpiper, dunlin, etc.) - fall staging and feeding on mudflats and salt marshes.

* Notes - Waterfowl subsistence hunting occurs in Fish Creek area. The Colville River Delta supports an intensive breeding bird use compared to other Arctic Coastal areas.

Reference: Rothe et al. 1982. Manuscript in preparation.

B. Kalikpik River

Similar values to Fish Creek/Colville River Delta except loons and swans are infrequent visitors and subsistence hunting is light. Mudflats and salt marshes are the significant habitats (Norton and Sackinger, 1981). The area is primarily high quality shorebird habitat, especially for staging and migration.

C. Kogru River

Similar values to Kalikpik River. Mudflats and salt marshes are the significant shorebird habitats.

D. Teshekpuk Lake/Cape Halkett (Teshekpuk Lake Goose Molting Area)

This area is probably one of the most diverse onshore waterbird areas on the Alaskan Arctic Slope. The following is a synopsis of major waterbird use:

* Black brant - nesting colony on "Island Lake" (over 100 pairs); 20 percent of world population attracted to area to molt (14-32,000 brant).

* White-fronted geese - breeding at scattered sites; a significant percentage of the NPR-A population is believed to molt in this area (5,000 geese).

* Canada geese - about 15,000 Canada geese molt in the area; all of these geese are believed to be of two subspecies: taverneri which nest in tundra habitats and parvipes which nest in interior forested habitats.

* Oldsquaw - a large percentage of the NPR-A freshwater molters utilize the area's large lakes; good breeding habitat.

* Lesser snow geese - the only breeding record for NPR-A was obtained here.

* Red and northern phalaropes - breeding as well as post-breeding and staging congregations.

The following excerpt from the NPR-A 105(c) Land Use Study describes this area's unique character:

> "It is not known why the lakes of the Teshekpuk Lake region are particularly attractive to geese. However, when viewed from aerial photographs the orientation and size of the area's lakes are noticeably different from surrounding areas. Traditional use of this area has probably caused nutrient enrichment of the heavily used shorelines. Numerous lakes within this region were used by geese, but larger lakes generally were most attractive to molting birds. Size of lakes is probably an important factor in selection by molting geese because of the security they provide from terrestrial predators and the greater longevity of the ice floes used as resting areas. Stage of lake development rather than size alone also appears to be important in selection since some large lakes attract many more molting birds than other lakes of similar size. Two partially drained basins (second generation) attracted up to 3,300 and 4,500 geese respectively. The lakes used by large groups are characterized by: 1) shorelines with gentle slopes, 2) moist, Carex-dominated vegetation adjacent to open water and 3) presence of shallow lagoon systems that provide important loafing, feeding and watering areas." (NPR-A Task Force, 1978)

References: King and Hodges, 1979; Derksen, Rothe and Eldridge, 1981;

Derksen, Eldridge and Weller, 1982; Derksen, Weller and Eldridge, 1979; Derksen, Eldridge and Rothe, 1979.

E. Elson Lagoon/Plover Islands

This area is the most extensive barrier island/lagoon system on NPR-A's Beaufort Sea coast.

* King and Common eider - shoreline migration; occasional resting in lagoon; and major subsistence hunting area.

* Red phalarope - staging on shoreline and barrier islands.

* Black guillemot - nesting colony on Cooper Island and among debris on Deadman and Igalik Islands.

* Ross' gull - feeding concentration of the majority of the world population in September and October; the Pt. Barrow spit and the western Plover Islands are especially important.

* Oldsquaw - molting and staging in lagoon.

* Arctic tern - nesting on barrier islands; and feeding in nearshore and offshore waters.

* Glaucous gull - feeding and staging in late summer.

Reference: Divoky, 1978 and 1979.

F. Peard Bay

* Oldsquaw - molting in lagoon.

* Black brant - observed in fall but level of use not established.

* Common eider - nesting on spits and islands.

* Guillemot - nesting on spits and islands.

* Arctic tern - breeding colonies on islands; the Seahorse Islands and the Pt. Franklin spit are major roosting and feeding areas.

References: Divoky, 1978 and 1979.

G. Avak Inlet/Kasegaluk Lagoon

This is one of the most important areas to waterbirds on the entire Chukchi Sea coast.

* Black brant - spring and fall staging in the lagoons and salt marshes; major concentration of over 100 brant molt in the area in July.

* Oldsquaw - molting and staging in lagoons and salt marshes.

* Common eider - nesting on islands; molting and staging in lagoons.

* Reference: Lehnhausen and Quinlan, 1982

H. Ledyard Bay and Vicinity

Impact analysis and protection of this area must be considered for any pipeline/road leaving NPR-A to the west.

* Common and thick-billed murres - feeding to support young; and feeding by non-breeders.

* Black-legged kittiwake - feeding to support young; feeding by non-breeders; and gathering nesting material.

* Common and king eiders - molting, staging, and feeding.

* Canada and white-fronted geese - staging in fall in nearshore areas and lagoons.

* Northern phalarope - shoreline staging in fall.

* Glaucous gull - feeding.

Reference: Springer et al., 1979; Springer et al. 1982.

I. Lisburne Peninsula Bird Nesting Colonies

Cape Lisburne - murre and kittiwake colonies on cliff; a significant portion of the black guillemot population nesting in Alaska; feeding radius extends to 100 kilometers to sea (radius is species dependent).

Cape Lewis - murre and kittiwake nesting colonies on cliffs with oceanic feeding probably including Ledyard Bay.

Cape Thompson - murre and kittiwake nesting colonies on cliffs with feeding radius extending 100 km to sea.

Reference: Springer et al. 1979; Springer et al., 1982.

Note: Point Hope has been identified by the panel as an important shorebird staging area.

J. "General" Use of NPR-A Land and Freshwater Habitats (within 20 miles (35 km) of the coastline)

Nesting, brood rearing, molting: black brant, whistling swan, Canada goose (nesting use unknown), oldsquaw, and shorebirds - post-breeding staging.

K. "General" Use of NPR-A Coastline and Marine Waters (up to 5 km offshore).

* Black brant - migration staging in lagoons; and feeding in salt marshes.

* Common eider - nesting on barrier islands; molting in lagoons.
    * King eider - migration along coast; occasional feeding in lagoons.

* Oldsquaw - molting and staging in lagoons.

* Arctic tern - nesting on barrier islands.

* Ross' gull - feeding in littoral and nearshore areas.

* Glaucous gull - nesting on barrier islands and feeding in lagoons and ocean.

* Phalaropes - feeding.

* Guillemot - nesting on barrier islands.

* Murre/kittiwake - nesting at sea cliff colonies at Cape Lisburne and feeding in lagoons and ocean.

DISCUSSION

I. Action/Response Analyses

The panel identified and evaluated the levels of impact associated with various types of development activities. The panel stressed that the level of response depends to a large extent on the particular species of waterbird considered.

A. Aircraft Traffic

Summer aircraft overflights disturb or disrupt the behavior of waterbirds. A single episode may lead to nest failure. Continual disturbance or harrassment may lead to widespread nest failure or increased predation upon molting birds. Barring intentional harrassment of waterbirds, the factors influencing the degree of disruption/disturbance (or response) is largely a function of:

1. Frequency of overflight. The panel recommended that overflights of sensitive habitats be permitted only on a case-by case emergency basis.

2. Type of aircraft (helicopter vs. fixed wing) including overall aircraft size and operating characteristics such as noise volume. In general, helicopters produce the greatest response.

3. Whether aircraft are restricted to established corridors over low use areas for waterbirds (to lessen response) or pilots are allowed to chose their own flight path.

4. Operating altitude is one of the most critical factors. In general, the more altitude, the less the disturbance.

5. Species of waterbird being overflown.

6. Seasonality of disturbance, which may cause different types of reactions such as nest desertion, brood mortality, or increased stress to molting birds.

B. Pond/Lake Drawdowns

Overuse of unfrozen water from any pond or lake on NPR-A during exploration, development or operation of oil fields on NPR-A can decrease the value of that aquatic habitat for waterbirds. Although it is recognized that use of this water for activities such as ice roads to replace the need for permanent roads may lessen total impacts upon waterbirds in the long-term, careful consideration must be given to the choice of a waterbody(s) to be utilized and to the alternate construction of artificial reservoirs.

C. Summer Seismic (geophysical exploration)

The panel was most concerned with summer operations on the Coastal Plain. Support activities associated with summer geophysical operations may cause extensive disturbance in some areas. Surface damage due to use of explosives is considered a minor impact but intensive helicopter overflights required to support these operations may reduce waterbird use. In areas of high levels of summer waterbird use, only winter geophysical surveys are recommended.

D. Erection of Powerlines and Towers

Any activity which leads to the erection of powerlines, radio towers, guywires, or tall beacons has the potential of inflicting direct mortality on flying waterbirds via collisions. Final facility design and siting must be based on intensive site-specific data on patterns of waterbird use.

E. Toxic Material and Waste Handling and Disposal

Sewage, solid waste, drilling muds, crude or refined petroleum products and other substances associated with petroleum exploration, development and operation of fields in NPR-A may result in direct or indirect mortality of waterbirds and/or alteration of presently pristine habitats. Complete containment of all toxic materials is necessary to protect waterbirds and their habitats.

F. Surface Transportation

Surface transportation can take many forms on NPR-A: cat-trains in winter, low surface pressure wheeled vehicles and hovercraft off-road in both winter and summer, and vehicles utilizing potential permanent all-season roads. Winter traffic on pre-selected low terrain impact routes was not considered a problem.

Summer use of rolligons and hovercraft could produce severe disturbance impacts to waterbirds including nest destruction. Route traveled and operating characteristics (noise, vibrations, expected surface damage, etc.) as well as opportunities for vehicle or direct worker harrassment of waterbirds must be investigated on a case-by-case basis before a permitting decision is made.

Impacts stemming from the use of permanent roads would probably be functions of:

1. Road routing

2. Traffic levels

3. Control of drivers and passengers to prevent waterbird harrassment while workers are in or out of vehicles.

4. Most importantly, roads alter the surface and surrounding vegetation due to:

   (a) impounding surface flow - culverts are not sufficient to maintain sheet flow; in fact most culverts are ineffective in even defined drainages; and

   (b) dust - dust dispersal from a road increase nutrient dispersal; decreases snow albedo and thereby increases soil moisture due to early snowmelt along roads with corresponding changes in phenology of plants; and may change the soil pH. Control of dust by application of drilling muds or petroleum binders to the road surface may introduce contaminants into the surrounding tundra and waterways.

G. Site-Selection, Construction, and Maintenance of Roads, Pads and Pipelines

Effective mitigation of temporary or permanent structures begins with proper design and site-selection. Areas where no surface occupancy is preferred should be identified before the lease-tract evaluation process so that proper tract boundaries can be drawn.

General recommendations for mitigation of these activities should be designed to decrease the residual impacts of disturbance and habitat alteration remaining after proper site-selection. Level of impact was considered to be a function of:

1. Site of activity

2. Type of activity

3. Amount of habitat alteration involved. The panel pointed out that habitat alteration is not merely restricted to the amount of tundra covered by or adjacent to a road or pad. Inadequate drainage for sheet flow or defined flow can alter large areas both up and down slope. Innovative approaches to minimizing drainage alterations are desperately needed.

4. Amount of human and vehicular activity required for construction, operation and maintenance of the proposed facility.

5. Bird species involved.

H. Site Rehabilitation

The panel agreed that the term "rehabilitation" is more appropriate than "restoration" for Arctic operations. The "habitat" underlying a gravel or sand pad in the Arctic can never be restored to its "original" condition; even restoration to a "natural" condition is questionable. Rehabilitation in the

Arctic should insure that the abandoned pad is stabilized and all toxic material removed. Nevertheless, the pad will always remain identifiable as a man-made anomaly in the surrounding tundra. On the Coastal Plain, the pad may provide acceptable habitat for plovers or ruddy turnstones that prefer dry sites. However, each site rehabilitation must be considered on a site-specific, state-of-the-art basis. The long-term benefits of fertilizing and seeding gravel structures in NPR-A as "rehabilitation" is questionable. Rehabilitation requirements must be based on site-specific requirements instead of the "one solution for every case" approach used for NPR-A to date. Conflicting rehabilitation requirements of different permitting authorities must be avoided. It must be remembered that different waterbird species may respond differently to various rehabilitation methods.

I. Gravel/Sand Removal

The response of waterbirds to gravel/sand extraction relates to the source of the material and the extent of habitat alteration involved. The Coastal Plain of NPR-A is not known to contain any large deposits of gravel. Gravel in areas such as barrier islands and shorelines are relict deposits. This gravel is a non-renewable source of material which may be of critical value to waterbird use. Impacts on waterbirds will relate to the extent the removal alters the physical environment and appears to be a function of:

1. Material source on Coastal Plain vs. waterbird use

2. Season of extraction

3. Type and extent of extraction

4. Site restabilization sucess

J. Noise, Movements of Men, Machines at Site Operations

The panel pointed out that the disturbance response of waterbirds to site-specific operations would probably be at least directly proportional to the level of activity. However, if on-site operations include inadvertant or intensional harrassment, response would probably be much greater than directly proportional and may lead to desertion of petroleum activity areas with resultant loss of population if alternative habitats with unfilled carrying capacity are not present. Waterfowl are generally much more susceptible to these kinds of disturbances than are shorebirds.

K. Increased Opportunity for Human Access

Any airstrip, road or coastal facility constructed in NPR-A increases human access to waterbirds. The panel felt that within industrial enclaves, oil field worker/waterbird interaction may be controlled via stipulation (that is, no hunting, no movement by humans off of facility pads, air traffic control, etc.) to a point where the residual rule breaking may be tolerable to waterbirds at the population level. However, the panel believed that if the designation of airstrips, roads and other transportation facilities was changed from industrial use only to public use, any increased sport hunting of waterfowl or habitat destruction resulting from public use may conflict with subsistence use.

L. Construction, Existence and Vessel Use of Port Terminals

The response of NPR-A waterbird populations to the establishment of coastal port facilities would be a function of:

1. Port location on the coastline.
2. Coastal processes alterations stemming from construction and existence of a port causeway or sand/gravel mining area.
3. The frequency and amount of barge transported fuel spilled and/or spills of crude oil during transport to market.
4. The total reaction of waterbirds to the establishment of ports with human activities, vehicles, wastes, towers/transmission lines, etc. in an area traditionally used for migration staging, migration flyways, and other intensive waterbird uses.

M. Attractions of Avian Scavengers to Development Sites

Scavengers such as gulls may concentrate at garbage disposal sites. Although the concentration of avian scavenger birds may seem benign to the layman, large concentrations of scavengers can lead to easier disease transmission, especially avian cholera, increased predation by gulls on the nests and young of nearby breeding waterbirds, and direct bird mortality by aircraft collisions (with inherent air traffic safety implications).

II. Synopsis of Play No. Two Analysis

The basic outline of Play No. Two assumptions is given in the preceding section of this document as "Background to the Workshop". Most of the discussion revolved around activities within the Teskekpuk Lake goose molting area (Smith River Field and the northern portion of Kogru River Field). The notes of this discussion follow:

A. Smith River Field

With present technology and past experience at Prudhoe Bay and Kuparuk, even "limited entry" (that is, field design to give large no surface occupany areas) combined with "seasonal restrictions" (that is, complete field shut in during the goose molting period with complete evacuation of all personnel) could reduce or eliminate use by molting geese. The "worst case" prediction, to total displacement, would result in the loss of molting use to about 1/5 of the world's population of molting black brant (about 30,000) and loss of molting use to about 5,000 white-fronted geese and 15,000 Canada geese with accompanying loss of use to nesting birds. However, there really is no mechanism for accurately predicting the level of population response to any development within this area be it an oil field, permanent road or other facility because so many of the pieces of the equation relating to waterbird use and disturbance are unknown. It is surmised that the greatest danger would be for a development to be so large as to displace all molting geese to unknown areas. If that were to occur, the resultant impact might only be discovered in subsequent years' flyway population counts. Because both the tendency for the geese to use specific lakes within the area and their ability to adapt to other areas is poorly understood or not known, the percent of total population affected at any level of development cannot be adequately predicted.

The panel tried to evaluate developments in isolated portions of the Teshekpuk Lake area with no conclusive result. Even a worst case analysis stating a direct relationship of ten percent occupied habitat resulting in ten percent loss of molting birds could not be substantiated due to the unknowns regarding goose molting carrying capacities within and without the area of habitat loss, possible unknown synergistic or cumulative impact mechanisms operating within the area and lack of information concerning possible availability and possible use of molting areas totally outside the Teshekpuk Lake area.

Therefore, the panel recommended withdrawal of the Teshekpuk Lake goose molting area from leasing consideration due to the unknown but potentially devastating effects resulting from development in the area (see Figure 2).

B. Northern Portion of Kogru River Field

The northern portion of Kogru River Field in Play No. Two should be developed only with a "no surface occupancy" stipulation to protect the salt marshes.

C. Gravel from the Colville River Delta

1. Removal of any gravel existing in the Colville River Delta must avoid valued wetland types and black brant nesting colonies to minimize impacts.

2. It may be preferable to dredge gravel from active channels, if downstream effects can be controlled, rather than mining gravel from the delta floodplain.

3. In general, the selection of a material site should be given equal consideration with the selection of a facility site. That is, a facility should not be approved on the NPR-A Coastal Plain until the potential impacts associated with obtaining the construction materials are known.

D. Colville River Bridges

Permanent (all-season) bridges across the Colville River should be of a design that does not restrict river flow or increase water velocity. Provision should be made on any bridge for attachment of a pipeline(s) to avoid a separate pipeline crossing. Bridges should be sited and designed to minimize impacts on waterbird use or habitat.

E. Permanent Roads

The panel recommended that no permanent roads be allowed in the Teshekpuk Lake goose molting area. The rationale was the same as that used for recommending no oil and gas leasing in this area: inability to accurately predict other than "worst case," and therefore unacceptable impacts.

F. Alaktak River/Chipp River Fields and Roads

The panel consideration of the remainder of Play No. Two was brief: no significant impacts envisioned assuming site specific restrictions on siting of facilities and restrictions on permissible activities. It was felt that the "normal" BLM/MMS and other agency controls on activities envisioned in Play No. Two, outside of the Teshekpuk Lake goose molting area, would lend sufficient protection to waterbirds. However, these "normal" controls must include adequate resource inventories and consideration of all impacts and mitigations prior to a permitting decision.

III. Synopsis of Play No. Four Analysis

As with Play No. Two, the basic assumptions of Play No. Four are given in the "Background to the Workshop" section of this document. Due to previous consideration of the sensitivities of the Peard Bay area with regard to waterbirds the panel discussions focused on the routing of the pipeline/road corridor to Cape Thompson/Chariot and the impacts of the new western port development.

A. Routing of Pipeline/Road Corridor

This corridor should avoid approaching coastal areas and inland extensions of coastal habitats (salt marshes, estuaries, etc.) by at least two miles. This setback would be considered adequate in most areas to avoid disturbances of coastal waterbirds and allow sufficient reaction time to prevent pipeline oil spills from reaching the marine environment.

B. Lisburne Peninsula Pipeline Terminal

The selection of Cape Thompson for a pipeline terminal with offshore loading will likely impact cliff-nesting birds and cause disruption of the along shore marine food web by causeways or oil spills. Point Lay or other areas "upstream" of the ocean currents flowing past Lisburne Peninsula bird colonies would be biologically preferable for establishment of port facilities. Spills "downstream" and in close proximity to those colonies could result in the oiling of large numbers of adult seabirds, and during late summer, large numbers of flightless murre chicks. Therefore, the potential for large-scale mortality is high.

RECOMMENDATIONS

I. Recommendations for NPR-A Areas of Special Concern with Respect to Waterbirds (see Figure 2).

A. Fish Creek/Colville River Delta

1. Delay leasing until last year of 5 year program to allow completion of ongoing baseline studies on waterbird use.

2. Through design of lease tracts (preferred) or leasing/permitting stipulations, provide for no surface occupancy of salt marshes.

3. No summer geophysical exploration.

4. Place restrictions on late summer air traffic over salt marsh areas including recommended horizontal/vertical distances to be maintained.

5. Restrict construction to winter to reduce need for permanent roads.

6. Minimize the need for permanent roads.

B. and C. Kalikpik and Kogru Rivers

1. Through design of lease tracts (preferred) or leasing/permitting stipulations, provide for no surface occupancy of salt marshes.

2. No summer geophysical exploration.

D. Teshekpuk Lake/Cape Halkett Area

1. Delete from leasing program - design solutions are not presently known to alleviate potential impacts.

2. Maintain present overflight restrictions (20 May through 25 August, 1000 foot minimum ceiling for air traffic).

E.,F., and G.
Elson Lagoon/Plover Islands; Peard Bay; and Avak Inlet/Kasegaluk Lagoon

1. Through design of lease tracts (preferred) or leasing/permitting stipulations, provide for no surface occupancy of coastline, barrier islands or salt marshes.

2. No mining of sand/gravel from islands, spits, or coastlines that provide waterbird habitat.

3. No summer geophysical exploration.

4. No coastal facilities except as recommended in following section.

5. Place restrictions on late summer air traffic over salt marsh and coastal areas including recommended horizontal/vertical distances to be maintained.

Note: Ledyard Bay and Lisburne Peninsula (see Synopsis of Play No. Four Analysis)

II. Recommendations for the BLM/MMS Management of Oil and Gas Development on NPR-A

A. Because most biological surveys of NPR-A to date have been general with few site-specific studies, it is imperative that BLM/MMS enforce their regulations to the maximum to require any Lessee or Applicant to conduct intensive site-specific and general regional surveys, during appropriate seasons, to supplement existing information. These studies must document the type of habitats and animal use surrounding any proposed activity area. This recommendation is emphasized for the Coastal Plain, where there potentially are more high use areas that have not been identified.

B. Realizing that BLM/MMS will depend to a large extent upon site-specific biological information provided by the Lessee or Applicant in making the best management decision, it is fundamentally important that this documentation of habitat and use be accurate and adequate. Although BLM/MMS cannot, and should not, institute a program of examining the expertise and ethics of the personnel conducting these studies for the Lessee or Applicant, quality assurance must be provided by BLM/MMS field checking of data and/or interagency and public review of submitted information. Given the short time frame for decisions on MMS permits, it may be necessary to establish a procedure whereby the information could be quickly reviewed by a few individuals outside the various permitting processes with sufficient expertise in the areas of biology involved to avoid permitting errors.

C. To avoid, to the extent possible, the pressure to approve (permit) less than optimal petroleum development activities, BLM/MMS should require the Lessee or Applicant to submit at least one fully researched and study documented alternative to the proposed action. This alternative could be presented as either a totally separate plan or an alternative to each site-specific action in the Lessee or Applicant's preferred plan. To avoid the problem of Lessee or Applicant submittal of totally spurious or sham alternative plans, BLM/MMS must inform the potential permittee that both the preferred and the alternative plans must be acceptable. It must be remembered that present NPR-A lease stipulations place the burden of proof upon the Lessee or Applicant to demonstrate that their planned activity will not result in unacceptable impacts. BLM/MMS must utilize this leverage responsibly and professionally to examine all applications for exemption to stipulations.

D. Encourage use of aircraft flight corridors. Aircraft flight restrictions regarding lateral distances and minimum altitudes to avoid disturbance to animals are inherently difficult to enforce and may, in certain weather conditions, be unsafe to the pilot and passengers. Therefore, it is recommended that flight corridors be defined by BLM/MMS and Lessee/Applicant agreement to minimize wildlife disturbance primarily in summer. Use of the corridor would be mandatory except in emergencies. Several methods of corridor establishment have been suggested:

1. Provide all pilots operating for a Lessee/Applicant with corridor maps including recommended minimum altitudes to be maintained if safety permits.

2. Require the Lessee/Applicant to provide an "air traffic controller" at each activity site responsible for advising pilots on approach as to recommended flight path and altitude (enforcement could require monitoring/recording these ground to air conversations).

3. In extremely sensitive areas, the flight corridor could be defined by the placement of remote on the ground beacons to allow pilots to utilize "radio directional finder" navigation to remain within the corridor.

4. At highly developed airstrips sustaining high levels of all-season traffic, the Lessee/Applicant could be required to upgrade air traffic control equipment sufficiently to be able to monitor all air traffic within its area and recommend course or altitude alterations to pilots to minimize wildlife disturbance and to prepare performance reports/recordings of compliance.

The panel felt that much of the problem with aircraft disturbance/harassment of wildlife is more a result of pilots who are either unaware or insensitive to the consequences of their chosen flight operation. It is recommended that BLM/MMS strictly enforce Sale 822 Lease Stipulation 1.(b) and require all pilots to undergo an environmental awareness training program. It is additionally recommended that the Lessee/Applicant discharge any pilot known to have violated recommended flight paths or altitudes for other than reasons of safety or emergency.

E. To the maximum extent possible, insure the maintenance of natural drainage patterns and processes with respect to the design and construction of any surface alteration.

F. To the maximum extent possible, avoid/exclude alteration of riparian, salt marsh, estuarine, lagoon, coastal or wetland habitats during the design and construction of any surface facility.

G. To the maximum extent possible and consistent with caribou passage protection measures, build all infield and market trunk pipelines within wetland habitat adjacent to the roads required for all season access. This will minimize land area disturbed and allow these permanent roads to be used for pipeline construction work pads and inspection/maintenance access.

H. Assure that the selection of construction material mining sites in the gravel poor Coastal Plain of NPR-A are given at least as much, if not more consideration in the permitting processes as are given to site-specific facility plans. All of the known small deposits of surface gravel on the Coastal Plain are non-renewable resources important to fish and wildlife habitat. Construction material extraction anywhere on the NPR-A where and when proven to be prudent, should, at a minimum, follow the guidelines developed by Woodward Clyde Consultants (1980 a and b).

III. Recommendations for NPR-A Coastal Support Facilities.

A. Icy Cape DEW Line Site (abandoned) - Recommend against use due to importance of the environs to staging and migration of waterbirds.

B. Nokotlek Point (Husky Point) - This site was used by the USGS/Husky Oil exploration program. Reuse is questionable but preferred over Icy Cape.

C. Wainwright - Preferred Chukchi Sea site for establishment of support facilities for both onshore and offshore activities.

D. Peard Bay DEW Line Site (abandoned) - Second in preference to Wainwright as Chukchi Sea support base so long as no activity occurs in Peard Bay.

E. Naval Arctic Research Laboratory (NARL) (mothballed) - Reopening of NARL as an industry and scientific support base is the recommended plan of the panel to support all NPR-A petroleum development activities.

F. Lonely DEW Line Site (Active) with adjacent Camp Lonely (mothballed) -The panel recommends abandoning Camp Lonely or moving it. Reuse of Camp Lonely would restore heavy summer air traffic in the Teshekpuk Lake goose molting area and increase pressure for a permanent road to inland NPR-A oil developments.

G. Cape Halkett (owned by Arctic Slope Regional Corporation) - The panel recommended against the permitting of any permanent road to Cape Halkett connecting it with onshore oil developments.

H. Kogru River DEW Line Site (abandoned) - The panel recommended that the Kogru River site not be developed as an industry support base due to increased summer air traffic over and pressures for permanent roads through the Teshekpuk Lake goose molting area.

IV. Applied Study - Recommendations to Support the NPR-A Leasing/Permitting Programs.

A. Teshekpuk Lake Goose Molting Area (Teshekpuk Area) - At the present time, the panel does not believe there is sufficient information to adequately predict the consequences of petroleum development activities within the Teshekpuk Lake area. Therefore, the recommendation of the panel has been to delete this area from the leasing program. Without studies to help answer the following questions, the panel does not believe its recommendation should be modified.

1. What is the level of fidelity or traditional use of the Teshekpuk Lake area by individual geese? (That is, do the same group of geese and their offspring use the area each year?)

2. What is the level of fidelity or traditional use of the Teshekpuk Lake area with respect to specific molting sites. (That is, do the same geese use the same sites every year?)

Answering these questions will require annual marking and observation of a substantial portion of the molting goose population. The results of this study could then be utilized to more accurately predict the effects of development actions in portions of the area.

3. What are the biological or physical characteristics of the Teshekpuk Lake area that make it so attractive to molting geese? Are these characteristics even approached in any other NPR-A Coastal Plain area, making that area potential alternate habitat for geese displaced by development?

The answer to this question would require intensive nutritional studies for geese, nutrient cycling studies, physical and chemical process studies both within the Teshekpuk Lake area and in other "similar" NPR-A areas.

4. Specifically, how will molting geese react to petroleum development activities in the Teshekpuk Lake area?

Although this question can be simply stated, study design is difficult. Case history information is extremely limited. Careful, innovative design of appropriate experiments will be needed to "test" the question without destroying the resource.

5. Is it true, as suspected, that most of the white-fronted geese molting in the Teshekpuk Lake area represent the majority of non-breeders of NPR-A or even of the North Slope?

   Studies undertaken for questions 1 and 2 would probably answer this question.

B. Ross' Gull - Why do large numbers of surface feeding species gather in the Pt. Barrow/Plover Island area and what oceanographic conditions contribute to an increased abundance or availability of prey for these species. Because this area supports major concentrations of phalaropes, terns, and gulls an understanding of its biological oceanography will provide insights into an area that is of critical importance to a number of species. The majority of the world's population of Ross' Gull is dependent on this area for food in late September and early October (G.J. Diboky, pers. comm., 1982).

C. General Recommendations for Study.

1. Conduct bird surveys and ecological studies of the NPR-A and adjacent coastal lagoons to enable more responsible management decisions to be made regarding both onshore and offshore (in conjunction with OCS/MMS) leasing and permitting.

2. Conduct waterbird surveys and disturbance studies on the Tangent Point peninsula (the peninsula between Admiralty Bay and Smith Bay) to enable responsible specific management decisions to be made for the peninsula and, if possible, extrapolation of disturbance studies to similar areas of NPR-A to support permitting decisions.

3. Conduct a photogrammetric inventory of the NPR-A Coastal Plain (utilizing existing imagery) to identify discrete areas of waterbird habitat within or adjacent to lease areas where no surface occupancy may be the best available management technique.

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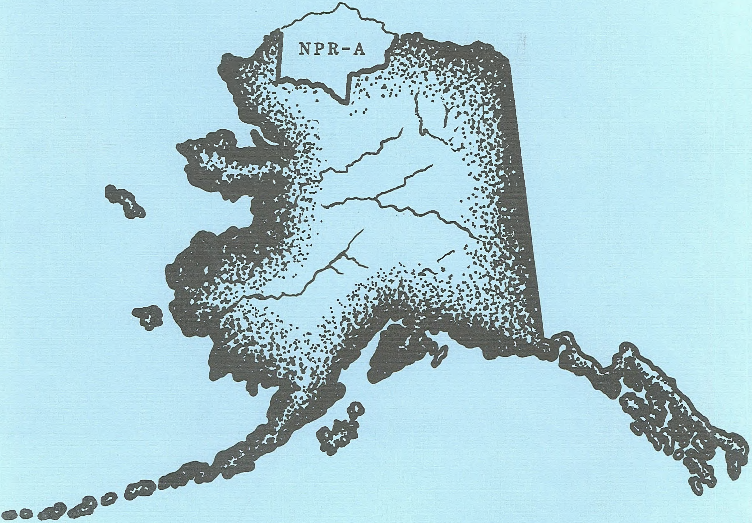
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